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# BOTANY.—*Adventitious bud and stem relationship in apple.*

HAIG DERMEN, Crops Research Division, U. S. Department of Agriculture, Beltsville, Md.

(Received May 12, 1959)

Under a title as of the present article some details relating to adventitious bud development on the stem of apple were reported at the 1956 meeting of the Botanical Society of America. The following note on this subject appeared in the mimeographed "Abstracts" assembled for the abstracts of the papers presented at the meetings of the General Section of the Botanical Society: "In early March of this year 10 one-year-old apple trees of the variety Maiden Blush were cut back to about 12″, planted in 10″ pots and disbudded to induce adventitious bud development on the stem. A number of buds developed endogenously on the stems adjacent to scars of cut-off buds as well as in internodal regions. Buds were examined by making serial tangential cuts under them. Under the normal buds, three leaf traces and a bud trace could be followed into the stem pith but *no* trace of any nature was observed in the stem behind the adventitiously induced buds. Adventitious buds which developed near normal bud scars had no connection with any leaf or bud trace. The results reported here verify and extend conclusions made previously with similar material."

General information on the subject here discussed appeared in earlier publications (Dermen, 1948, 1951a, 1955a). Some additional details with illustrative material are presented here. This article will also formalize the note quoted from the mimeographed abstract.

Fig. 1-*A* shows a 1-year-old tree of Maiden Blush apple disbudded to induce development of adventitious buds on the stem. Round scars along the stem mark the nodal regions where normal buds were cut off. Arrows *a* and *b* point to two adventitious buds that developed several weeks after normal buds were excised. The same two buds are shown in the enlarged photograph in Fig. 1-*B* indicated by arrows. The same portion of the stem, shown in Fig. 1-*C* from side view in respect to the buds, shows the upper bud already grown into a shoot and the lower one barely grown through the bark.

Fig. 2 shows an adventitious bud (indicated by an arrow) from another tree of Maiden Blush lifted from the stem with a piece of bark attached and sectioned by the free-hand method with a razor blade. The bud was still inside the bark when lifted from the stem and the bark over the bud was barely cracked. In Fig. 2 the centrally located darkened region, appearing irregularly inside the bark, is where the bulk of the adventitious bud had developed. The curved portion at the upper side of the endogenous growth indicated by the arrow is the shoot apex of the bud. Sometimes from such endogenously proliferating growth more than one shoot emerged.

At the stage of adventitious growth shown in Fig. 2 no mark of any sort was detectable on the wood surface at the point of the adventitious bud growth when the bark was lifted; whereas behind all true nodal buds there were clearly visible marks of vascular tissue connection between leaf and bud at a node and the wood under the bark.

Figure 3-*A* shows an enlarged view of the scar of a normal bud. Figure 3-*B* shows vascular tissue markings on the wood of the stem when the bark at the bud scar (Fig. 3-*A*) is lifted from the stem. In this view there are on the stem four major vascular connecting points. Three vascular points marked *a*, *b*, and *c* are in a straight line; they indicate the three points of vascular connection between a leaf and the stem. The point of vascular connection between an axillary bud and the stem, marked *d*, is indicated by an arrow. The four markings in Fig. 3-*B* (*a*, *b*, *c* and *d*) are transverse views of traces of vascular tissue bundles from a leaf and a bud at a node of the apple stem extending through the wood to the pith of the stem. The few small dots around trace *d* are trace marks of scales and young leaves of the axillary bud.

Figure 4-*A* shows the view of the area of the shoot grown from the adventitious bud *a* in Fig. 1-*C* after the bark of the area was lifted. Arrow *a* points to the scar in the wood where a piece of fresh wood tissue had pulled off when the bark with the shoot was lifted, indicating the amount of wood tissue which had grown on the stem since the adventitious bud *a* (Fig. 1-*A* and *B*) had grown into the shoot in Fig. 1-*C*. In Fig. 4-*A* arrow *b* points to the central middle trace of the leaf at the node. Arrow *c* points to the left trace of the leaf. The right leaf trace cannot be seen in the view of the stem shown. Arrow *d* points to the main axillary bud trace. The small trace at the left of the main bud trace is one of the traces of the axillary bud scales.

Figure 4-*B* shows the stem at the same position in Fig. 4-*A*. Here is shown what re-

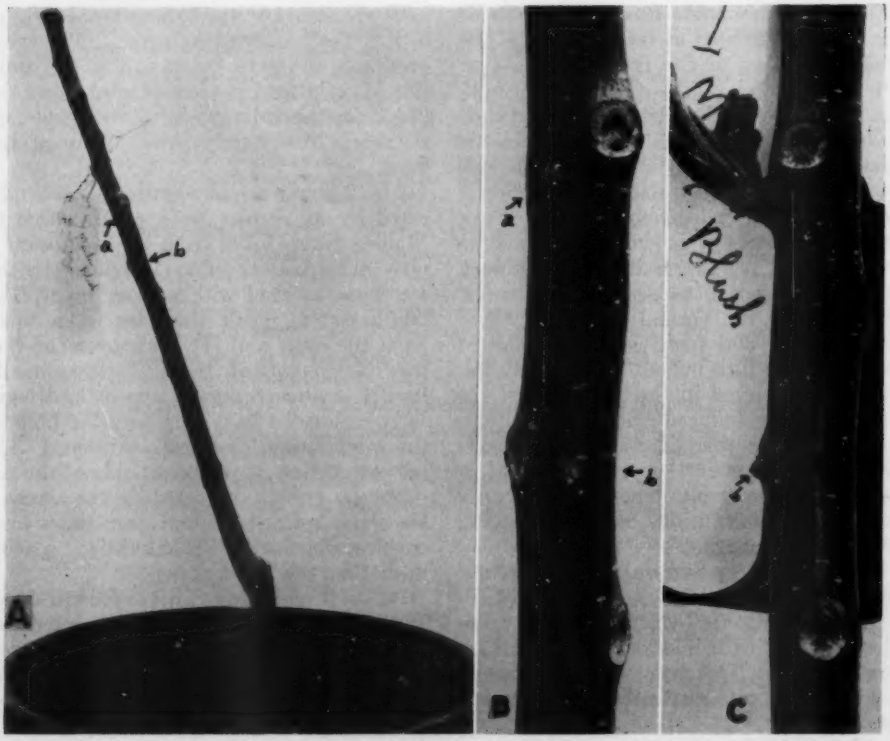


FIG. 1.—Two adventitious buds on the stem of a one-year-old tree of variety Maiden Blush apple. *A*, Two adventitious buds are indicated by arrows *a* and *b*. × ½. *B*, Enlarged view of the portion of stem of the same tree with the two adventitious buds. × 1½. *C*, Upper adventitious bud grown into a shoot, lower one barely emerged through the bark. × 1½.

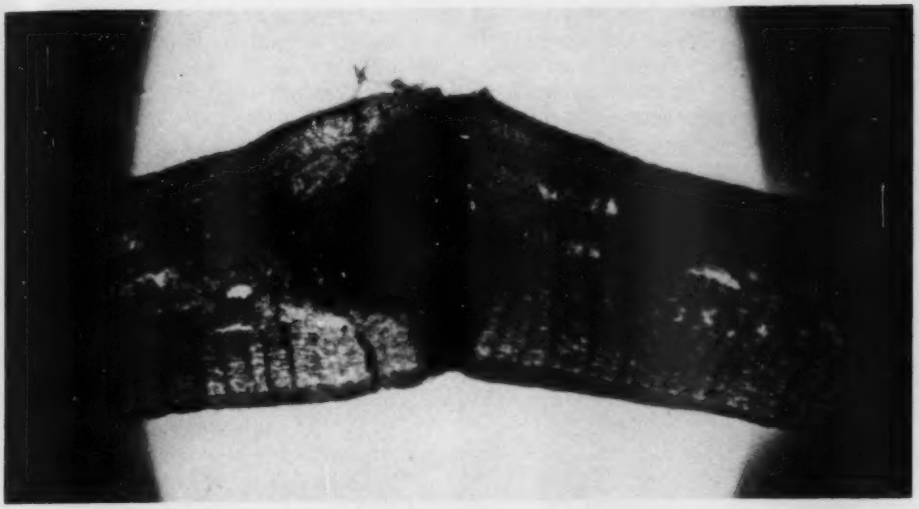

FIG. 2.—A highly enlarged view of cross section of bark with an adventitious bud or buds developing inside of it. × about 30.

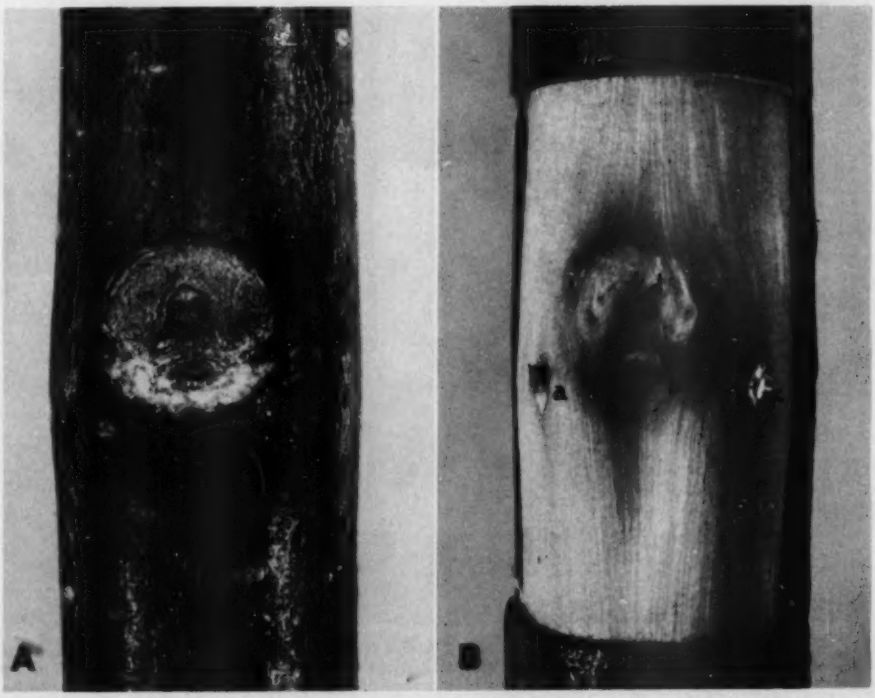


FIG. 3.—*A*, Large scar at a stem node after nodal bud was excised. *B*, The same node region as in *A* with the bark removed; *a*, *b*, *c* indicate transverse view of three vascular traces of leaf; arrow at *d* indicates transverse view of the vascular trace of the axillary bud. × 5.

mains when the wood in the area marked by arrows *a* and *c* in Fig. 4-*A* was shaved off with a razor blade. There was no vascular trace connection beyond the depth of the scar on the wood. In contrast to the situation just described, there was present the vascular trace of the leaf trace at arrow *c*. The traces of the leaf and the normal axillary bud could be followed through the wood tissue to the stem pith.

The adventitious bud *b*, shown in Fig. 1, was examined similarly. Figure 5-*A* shows the region of bud *b* after the bark was lifted. There was hardly any mark on the wood underneath the bud *b*. The location of bud *b* is indicated by an arrow on the back of the lifted piece of bark (Fig. 5-*B*). Other marks are those of the three leaf traces and that of the axillary bud trace. In Fig. 5-*C* the arrow points to the right trace of the leaf. No other markings could be found in the vicinity of the leaf

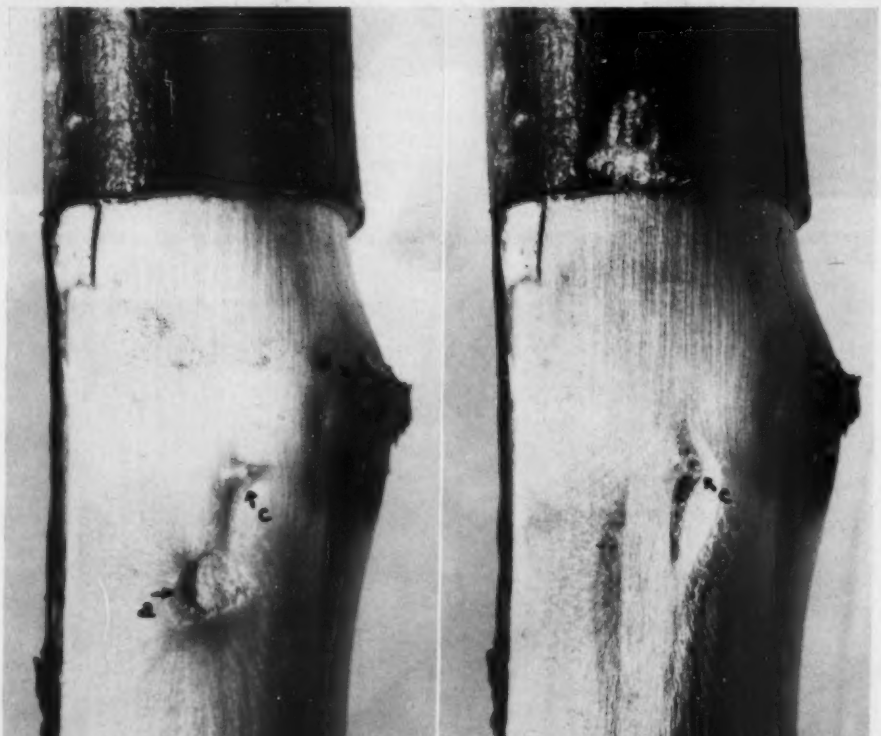


FIG. 4.—*A*, Area of adventitious bud *a* in Fig. 1-A and B. Arrow at *a* indicates the place from which a piece of wood tissue was pulled when bark and with it the shoot which had developed from bud *a* was removed. Arrows at *b* and *c* point to two vascular traces of the leaf at the node. Arrow at *d* points to the vascular trace of the axillary bud. *B*, The same area as in *A*. In *B* the area at *a* and *c* was shaved off. The figure shows the vascular trace at *c* is present, but there was *no* trace of vascular tissue back of the region *a*. × 5.

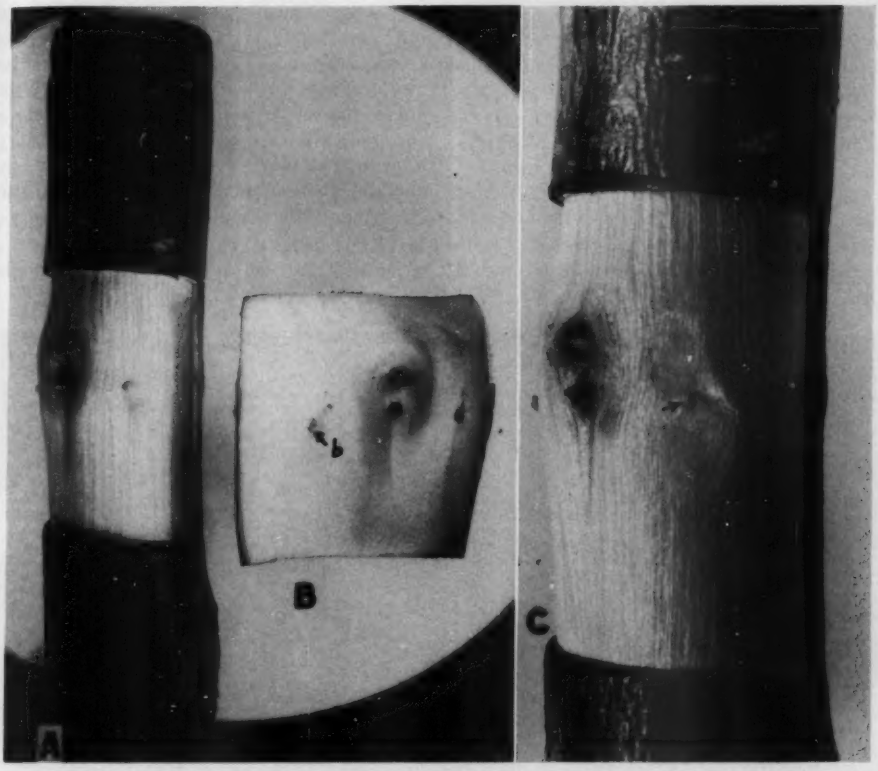


FIG. 5.—Illustration of absence of vascular trace behind adventitious bud *b* in Fig. 1. Other details in text. *A* and *B* enlarged × 2½; *C*, × 4½.

trace which would have indicated connections with the adventitious bud *b*.

The features just described give further evidence that bud development on the apple stem previously reported was truly of adventitious and endogenous origin and that such buds were not latent buds which could have been forced into shoot growth by heavy pruning (MacDaniels, 1953).

The method here followed to demonstrate whether a bud is of adventitious or of normal origin is useful and reliable, but not the only method, as results previously reported (Dermen 1951a, 1955a) indicated. Occasionally buds may originate in the nodal area where a scar has resulted from disbudding operation to induce adventitious bud growth. In such cases cuts in the scar area tangential to the stem surface would not reveal whether the vascular traces present were those of an adventitious bud or those of the axillary bud and the leaf which had been removed. If a bud appears in the scar region resulting from a cut carefully made, or in close proximity to a scar, and it has appeared in the manner described previously (Dermen, 1948, 1951a, 1955a) weeks or months after the disbudding operation, it surely must have originated adventitiously and endogenously through meristematic activity of cells of the callus tissue forming after a cut.

A tree of Winesap apple variety was determined to have a cytochimeral complex in which at the shoot growing point the two outermost cell layers, designated as L-I and L-II, were diploid ($2x$) and inner cell layers tetraploid ($4x$). This kind of chimeral plant is designated as 2-2-4 (diploid, diploid, tetraploid) type and functions sexually as dip-

loid (Dermen, 1951b). Some twigs and branches of this Winesap apple tree were found to have reverted to a completely diploid condition (Dermen, 1951b).

A number of attempts were made to obtain a completely tetraploid form of Winesap apple, along with some other varieties, by the adventitious budding method but failed (Dermen, 1955a). In previous experiments as many as two dozen trees had been used. Hoping that eventually success might be achieved with the chimeral Winesap, the number of experimental plants was increased to 60 one-year-old trees. Even then not a single adventitious bud growth occurred on the internodal regions of any of the trees. However, on many of them a large mass of callus grew in the scarred areas at the nodes from where normal buds had been cut. One such callus growth is shown in Fig. 6-*A*. The growth reached the size shown in 6 months, at the end of which two shoots

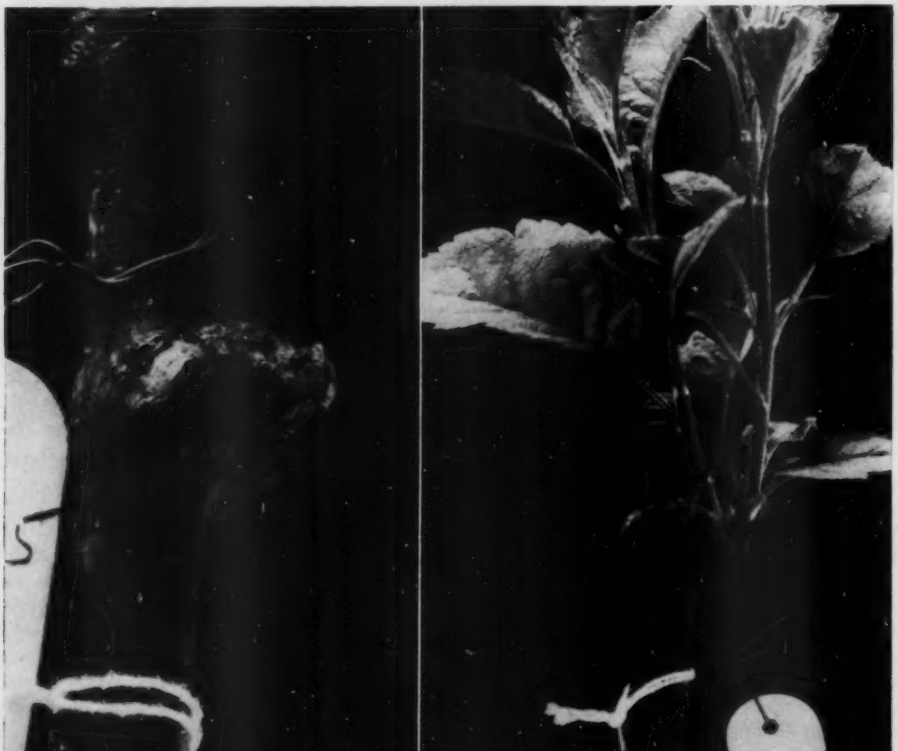


FIG. 6.—*A*, Large callus formation at a node of stem of Winesap apple with 2-2-4 type chimeral complex. Arrow at calloused region points to a swelling suspected of being an adventitious bud. × 2. *B*, Two diploid shoots from the calloused region. × about normal.

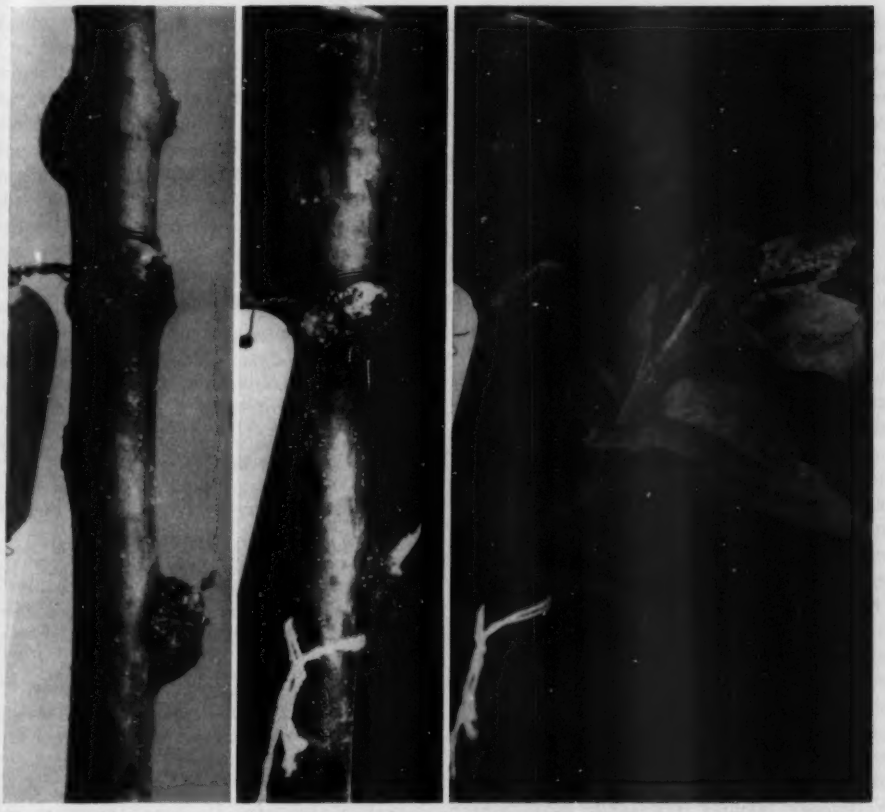

FIG. 7.—*A*, At the lower calloused node arrow points to bud developed adventitiously at the node of a stem of 2-2-4 chimeral Winesap tree. *B*, Shoot growth from adventitious bud. *C*, A leafy shoot growth from the adventitious bud; the shoot *was entirely tetraploid*. *A*, Slightly enlarged; *B* and *C*, normal size.

had begun to emerge (Fig. 6-*B*). The arrow in Fig. 6-*A* points to one adventitious bud with a smooth layer of tissue over it. On cytological examination both shoots were found to be homogeneously diploid.

One shoot also developed on another of the 60 disbudded trees. It also developed in a callused nodal region. In Fig. 7-*A* the arrow points to a swelling suspected of being an adventitious bud and growing into a shoot. In Fig. 7-*B* is shown a young shoot developed from the "bud" in Fig. 7-*A*, and in Fig. 7-*C* is shown the leafy shoot; *it was totally tetraploid* (Dermen, 1955c). This was the only instance in all the experiments that a tetraploid shoot was isolated from a 2-2-4 chimeral type of plants by the disbudding method (Dermen, 1955a).

## SUMMARY AND CONCLUSION

When tangential cuts are made behind the normal buds at the stem nodes, there are found in the wood a definite number of markings which are easily recognizable; these are the three vascular traces of a leaf and one major vascular trace of the axillary bud at a node seen at transverse sections. These markings represent cross-sectional views of vascular tissue bundles which connect a leaf and a bud at a node with the wood tissue. These traces can be followed through the wood tissue to the pith of the stem as cuts transverse to the traces are made successively. Similar tangential cuts were made into the wood behind what were judged to be adventitiously originating

buds. There were no such marks of vascular traces in the wood behind any of the adventitious buds. A bud or branch trace was present only in the amount of wood tissue grown after the adventitious buds have started growing into shoots. The present study confirms earlier reports concerning initiation of adventitious bud on the stem of apple by following disbudding method previously described. This study also makes it obvious that other methods followed demonstrating the nature of the adventitious buds developed on some apples were reliable. It is concluded that when 1- to 2-year-old apple trees, potted in 10- to 12-inch pots, are cut to stumps about 10 to 12 inches high and all the buds at all the nodes are removed, adventitious buds may appear either along the internodal space on the stem or near or in the nodal region. In the internodal and near the nodal regions adventitious buds originate in phloem tissue. In the nodal region they originate in the callused tissue. They appear as small swellings with a smooth surface. The smooth surface is ruptured and a shoot slowly grows from such an endogenously developed bud. The appearance of the swellings and emergence of a bud and its growth into a shoot may take weeks or months. Buds appearing in the manner just described are truly adventitious. Wellensick (1952) obtained adventitious bud growth on apple, pear, beech, birch and oak. MacDaniels (1953) failed to obtain such buds on the apple. At the base of a propagated shoot there are normal small buds close together, and some of them are difficult to see with naked eye. Bud and shoot growth from these buds which normally remain latent should not be confused with the true adventitious buds. When such buds show growth into shoots following disbudding of stems they should be destroyed so that they will not interfere with the initiation of adventitious growth.

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*It is the creatures which have their independent emotional life that give us the great lesson of our kinship with the lower stages of living. This lesson is sorely needed. I have known famous naturalists who had never come by either an intellectual or emotional understanding of their place in the chain of intelligence, and without this a man remains a stranger in this world.*—NATHANIEL SOUTHGATE SHALER.

BOTANY.—*New chiropterophilous Solanaceae from Colombia.* JOSÉ CUATRECASAS, U.S. National Museum, Smithsonian Institution.

(Received May 27, 1959)

Dr. Stefan Vogel, accompanied by the entomologist Dr. Helmut Sturm, both from the University of Mainz, Germany, spent one year, from 1955 to 1956, in northern South America (Colombia and Panama) conducting ecological research on pollination in the field. The main topic of the investigation was the pollination of flowers by bats. On this kind of fertilization there existed at the time positive information on about 20 genera, mostly of South Asian plants, but only scarce data were available from the American tropics. Before Dr. Vogel's studies, the existing reliable observations on fertilization by bats in the New World were limited to *Crescentia cujete* by Porsch in Central America and to *Eperua falcata* and *Bauhinia megalandra* by Hart in Trinidad; Porsch had quoted several genera, the flowers of which were supposedly visited by bats.

During his stay in Colombia and Panama, Dr. Vogel checked the visiting of flowers of about 17 species by long-tongued vampires of the subfamily Glossophaginae. He obtained on infrared film an amazing and fine documentation on the subject clarifying many details concerning the performance of bats. The species of Glossophaginae which were observed are: *Glossophaga soricina, Lonchophylla concava,* and *Anoura geoffroyi peruana.* The chiropterophilous plants and flowers studied by Vogel mainly were Bignoniaceae (*Kigelia aethiopica, Crescentia cujete*), Solanaceae (*Trianae, Markea*), Gesneriaceae (*Campanea*), Gentianaceae (*Symbolanthus*), Polemoniaceae (*Cobaea*), Melastomataceae (*Purpurella*), Papilionaceae (*Mucuna*), Bombacaceae (*Ochroma*), Cucurbitaceae (*Cayaponia*), Maregraviaceae (*Marcgravia*), Lythraceae (*Lafoensia*), and Capparidaceae (*Cleome anomala*).

A detailed and illustrated report on his research has been published by Dr. Vogel, which is recommended to the reader interested in this subject: *Fledermausblumen in Suedamerika,* Oesterreich. Bot. Zeitschr. **104** (4/5): 491–530, 10 figs. 1958.

Among the Colombian collections of chiropterophilous plants made by Vogel and Sturm, which I received for identification, three of the Solanaceae proved to be new taxa. Their descriptions follow. The illustrations are originals of Dr. Vogel.

**Markea vogelii** Cuatr., sp. nov.

Frutex epiphyticus caudice tuberculato lignoso ramis scandentibus prodeunti. Rami ramulique griseo-virides glabri.

Folia alterna integra crassiuscula chartacea. Petiolus glaber 4–8 mm longus semiteres tantum basi paulo incrassatus. Lamina oblongo-ovata vel oblongo-elliptica velsubelliptica basi rotundata vel obtusa apice attenuata acuminataque acutissima, margine sublaevis plana vel paulo revoluta, 5.5–9 cm longa 3–4.5 cm lata; supra in sicco griseoviridis glabra sed minute papillosa costa filiformi nervis secundariis paulo visibilibus venulis obsoletis; subtus viridulis costa eminenti nervis secundariis 6–8 utroque latere tenuibus prominentibus ascendentibus prope marginem arcuate-anastomosatis, venulis obsoletis parcissimis minutis pilis sparsis vel glabra, leviter papillosula.

Inflorescentia simplicissima floribus solitariis axillaribus ad terminationem ramulorum pendulorum. Pedicelli 1–1.5 cm longi glabri apicem paulatim incrassati cum brevi pedunculo articulati. Calyx crasse membranaceus circa 4 cm longus glaber prismatico-tubulosus supra medium lobatus lobis triangularibus acutis, tubo prismatico circa 2 cm lato comissuris sepalorum angulatis apparente carinatis; sepalis ovato-oblongis acutis uninervis 12–16 mm latis. Corolla luteo-viridis glabra crasse membranacea companulata basi tubulata in totidem 6.5–7.5 cm longa, tubo crasso circa 1.8 cm longo 0.8–1 cm diamitenti, limbo campanulato circa 3 cm diamitenti lobis oblongo-ovatis obtusis 1.5–1.8 cm longis latisque reflexis; petalis trinervis venulis laxi reticulatis inconspicuis. Stamina 5 filamentis apice teneris basim versus incrassatis robustisque basi barbulatis reliquis glabris 2.5–2.8 cm longis

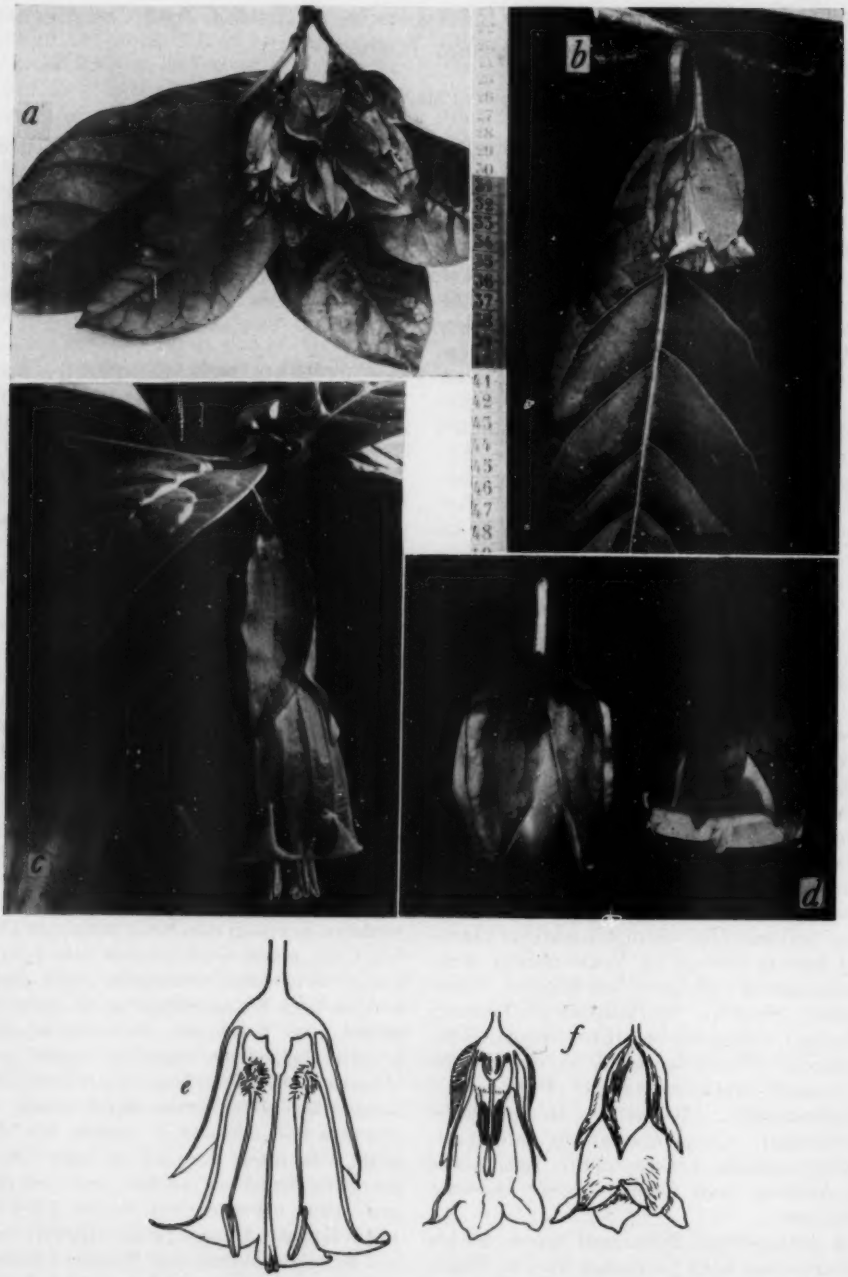


FIG. 1.—*a, b, d, e, Trianaea spectabilis* Cuatr. var. *brevipes* Cuatr., var. nov.; *c, Markea vogelii* Cuatr., sp. nov.; *f, Markea sturmii* Cuatr., sp. nov.

ad faucem corollam (apicem tubi) insertis; antheris basifixis pendulis crassis oblongis 1.6–1.8 cm longis circa 3 mm crassis birimosis usque ad basin dehismentibus. Discus crassus planus. Ovarium oblongo-ovoideum glabrum biloculare multiovulatum. Stylus circa 5.5 cm longus crassiusculus erectus apice 2 stigmatibus bilobatis decurrentibus.

Typus: Colombia, Cundinamarca: Cordillera Oriental, forests 1,800 m alt. above Monterredondo, between Guayabetal and Limoncito, 13-X-1956, *Stefan Vogel 159*. Holotypus US.

*Markea vogelii*, because of its life form, rather large flowers, and greenish corolla, is in some way closely related to *M. viridiflora*, but its tubulous-campanulate corolla is more similar to that of *M. venosa* and *M. neurantha*. The new species could be placed near numbers 6 and 7 in my key of the genus *Markea* (Feddes Repertorium Sp. Nov. **61**: 83. 1958), differing by its subchartaceous or submembranaceous leaves, its glabrescence, the shape and size of the calyx and corolla, and the yellow-greenish color of the corolla.

**Markea sturmii** Cuatr., sp. nov.

Frutex epiphyticus ramis tortuosis cortice pallido-griseo corrugato rhitidomatoso ramulis ultimis angulatis tenuibus glabris.

Folia alterna integra crassiuscule membranacea glabra. Petiolus subteres leviter incrassatus 3–4 mm longus. Lamina elliptico-lanceolata vel oblongo-lanceolata basi attenuata obtusa vel subacuta apicem versus angustata longe acuteque acuminata vel caudata margine laevi, 6.5–12.5 cm longa 1.8–4 cm lata, acumine 2–20 mm longo; supra sublaevis tantum costa filiformi notata reliquis nervis inconspicuis; subtus costa prominenti angusta nervis secundariis 6–8 utroque latere tenuibus prominulis patulis prope marginem arcuatis anastomosatisque leviter conspicuis venulis obsoletis reliqua superficie laevi.

Inflorescentiae pauciflorae ad ramulos pendulos ex axillas foliorum supremum, pedunculo 6–8 cm longo valde teneri sed rigidulo angulato glabro subapicem brevem ramulum orienti, ad apicem et in ramulo paulo incrassato 3–4 flores sessiles ferenti. Pedicelli in specimine absenti. Calyx crasse membranaceus viridis glaber subprismatico-campanulatus circa 1.8 cm longus 5-lobatus, lobis oblongo-ovatis subacutis uninervis 8–9 mm longis 6–7 mm latis (ad basim), tubo prismatico comissuris sepalorum angulatis carinata-prodeuntibus, venulis laxe reticulatis inconspicuis. Corolla crassiuscula viridis campanulata basi tubulosa in totidem 3–3.5 cm longa; tubo circa 7 mm longo 4–5 mm diamitenti; limbo late campanulato circa 1.5 cm diamitenti apice lobis reflexis ovalibus vel subrotundatis 7–9 mm longis latisque, petalis uninervis (costis) et laxe obsoleteque reticulato venosis, intus fauce (apice tubi) sparsissime pilosula reliqua omnino glabra. Stamina 5, filamentis crassis 1.5–2 mm longis subapicem tubi insertis parcis minutis pilis praeditis; antheris inclusis erectis crassis oblongis conniventibus 6 mm longis glabris 2-rimosis usque ad basim dehiscentibus. Discus crassus obtuse pentagonus fere planus. Ovarium ovato-conicum glabrum circa 3 mm longum, biloculare loculis multi-ovulatis. Stylus erectus glaber 1.2–1.3 mm longus apice stigmatibus duobus oblongis decurrentibus. Fructus ignotus.

Typus: Colombia, Huila: ridge of the Cordillera between Guadalupe and Florencia, forests 1700 m alt., 9-VI-1956, *Helmut Sturm 178*. Holotypus US.

*M. sturmii* belongs to the section *Merinthopodium* (D. Smith) Cuatr. and differs from all other species essentially by its very short staminal filaments. The size and shape of the calyx and corolla and the thin, rather small and lanceolate leaves also are unique. Although the thin peduncles of the inflorescences are not flexuose, these are pendant, because the terminal branchlets which bear them, are more or less flexuose and pendulous.

**Trianaea spectabilis** Cuatr. var. **brevipes** Cuatr., var. nov.

Frutex epiphyticus caudice tuberculato ramis scandentibus elongatis. Lamina foliorum late ovato-elliptica vel obovato-elliptica 20–29 cm longa, 9–13 cm lata. Stamina circa 8 mm supra basim corollae inserta. Stigmata 5 oblonga conniventia basim coalita. Ovarium 8–10 loculis. A specie typica pedicelli tantum 3.5–6 cm longi differt.

Typus: Colombia, Cundinamarca: Monterredondo between Guayabetal and Limoncito, Cordillera Oriental, forests 1,800–2,100 m alt., 6-XII-55. "Vermutlich epiphytisch aehnlich *Markea* wachsend mit grosser verholzter Knolle. An Baeumen von dieser Knolle aus lange kletternde verholzte, bis 15 m. hoch steigende Triebe aus-

bildend. Blueten einzeln, axillaer, haengend, oder gehaeuft am Ende beblaetterter Sprosse. Bisweilen Tetramerie meist pentamer. Wasserkelche. Blueten bei dieser Art die Kelchzipfel nur wenig ueberragend, Kronlappen spitz, Farbe gruenlich gelb. Blaetter lederartig. Unreife Fruechte beerenart." *Stefan Vogel 6*. Holotype, US; isotype, M.

These specimens are cited by S. Vogel in his extremely interesting studies on chiropterophilous flowers (p. 506, fig. 4–I). The only difference I can find between these and the regular typical *Trianaea spectabilis* are the short pedicels of the Vogel plants; this feature is remarkable, because the long flexuose pedicels are characteristic of the genus.

*Trianaea* was described from flowering specimens. Recently I received for study other collections with developed fruits which gave me the opportunity to study the seeds. These prove to be reniform, minutely alveolate and with a curved semicircular embryo. This character excludes the genus *Trianaea* from the tribe *Cestreae* and indicates that it belongs to the *Datureae*. (See also Cuatrecasas, J. *Notes on American Solanaceae*, Feddes Repertorium **61**: 83. 1958.)

## FORMER ACADEMY PRESIDENT MEMORIALIZED

A bust of Dr. Aleš Hrdlička (1869–1943), world-famous anthropologist who was associated with the Smithsonian Institution for 40 years, was recently presented to the Smithsonian's National Museum by Dr. Miloslad Ruzek, Ambassador of the Czechoslovak Republic to the United States. The gift was made on behalf of several educational and cultural groups of Czechoslovakia as a memento of the recent observances in that country marking the 15th anniversary of Hrdlička's death and the 90th anniversary of his birth.

The bust is the work of the Czech sculptor Milan Knobloch, based in part on a death mask of the scientist made by Andreas J. Andrews, Smithsonian sculptor. The original of the bust was unveiled last September in the entrance of the school that now bears Hrdlička's name in Humpolec, Czechoslovakia, the town where he was born.

Hrdlička came to America with his father in 1882. He studied medicine in New York and anthropology in Paris, and in 1903 was called to Washington to set up a division of physical anthropology in the U. S. National Museum. Here he spent the rest of his life and built up the collections in that department to rival those anywhere else in the world. He was founder and first editor of the American Journal of Physical Anthropology, and founder and first president of the American Association of Physical Anthropologists. He encouraged anthropology in Czechoslovakia, especially at Charles University, Prague, by gifts of books and money, one result of which is the Hrdlička Museum in the Anthropological Institute of that institution. He served as president of the Washington Academy of Sciences in 1929.

## HONORARY MEMBERSHIP

D. E. Parsons, chief, Building Technology Division, National Bureau of Standards, has been elected to honorary membership in the American Society for Testing Materials, "in recognition of long and distinguished service to the Society in both technical and administrative work, and for eminent leadership in the field of building materials and building technology involving both research and standardization."

# ZOOLOGY.—*Three new cave amphipods from the West Indies.* CLARENCE R. SHOEMAKER,[1] U. S. National Museum.

(Received March 27, 1959)

During the Smithsonian-Bredin Caribbean Expedition of 1958, caves of several of the Lesser Antilles were investigated. The first two of the new amphipods described below were collected by Desmond Nicholson, captain of the Expedition's vessel, *Freelance*, from a fresh-water stream in Dark Cave, Barbuda, on April 25, 1958. The third new species, the type of a new genus, was collected by Gilberto Silva Taboado during his investigations of the fauna of Cueva Grande, a large cave in Las Villas Province, Cuba.

Family BOGIDIELLIDAE Hertzog, 1936

Genus ***Bogidiella*** Hertzog, 1933

***Bogidiella bredini,***[2] n. sp.

Fig. 1

*Material examined.*—Two specimens, a male and a female, from Dark Cave, Barbuda.

*Description.*—FEMALE: Side lobes of head prominent and distally rounding; eyes absent. Antenna 1 less than half the length of the body; first joint of peduncle a little stouter and longer than second; second joint twice as long as third; flagellum about equal in length to the peduncle, and consisting of about 12 joints; accessory flagellum of 3 or 4 joints and reaching a little beyond the second joint of primary flagellum. Antenna 2, a little shorter than 1; gland-cone prominent; third joint half the length of the fourth; fourth joint a little stouter and a little longer than the fifth; flagellum shorter than fifth peduncular joint and consisting of 5 joints which decrease in length consecutively.

Mandible, cutting-edge with few teeth; accessory plate well developed, broad distally, without teeth, but with crenulate distal margin; 5 spines in spine-row; molar low and conical with a very small triturating surface which is armed with several slender teeth and a long seta; palp, 3-jointed, the second joint the longest. Maxilla 1, inner plate broad and bearing 2 plumose setae; outer plate with 7 spine-teeth which are nearly simple; palp 2-jointed, second joint bearing 3 slender terminal spines. Maxilla 2, inner plate a little wider but shorter than outer plate and armed with 7 spines; outer plate with 5 spines. Maxilliped, inner lobe reaching little beyond base of outer lobe, and armed distally with 3 slender spine-teeth and 3 setae; outer lobe reaching only to base of second joint of palp, armed distally with 3 spine teeth and 1 seta, on the inner margin with 4 setae; palp 4-jointed, fourth joint well developed, with a comb of fine spinules on inner surface, and bearing a slender nail having a spine and a seta at its base. Upper lip symmetrical. Lower lip with inner lobes poorly developed; side lobes short and blunt.

Gnathopod 1, longer and stronger than 2; second joint rather short, not as long as the sixth, somewhat, expanded for the greater part of its length; third joint short; fourth joint about as long as the fifth and with a brush of fine setae on lower margin; fifth joint produced below into a narrow lobe carrying a few spines; sixth joint very large and strong, widest proximally and converging to a narrow apex, rear margin short; palm very oblique and without defining angle, slightly convex, on the outside armed with about 20 short slender submarginal branched spines, and with a group of 3 slender spines at center, a row of 10 rather stout branched spines beginning on the rear margin of the joint and extending a short distance into the palm, each of these spines having a slender spine springing from its base; on the inside of palm there is a groove into which the seventh joint fits, defined by a row of 3 stout spines and a group of slender spines, below which is another row of 4 spines (Fig. 1, *l*); seventh joint long, ending in a short nail, on the inner margin are 2 short spinules distally and 1 spinule near the center, on the outer margin are 2 short setae. Gnathopod 2, second joint not as much expanded as that of gnathopod 1, and about as long as the sixth joint; fifth joint half the length of the

[1] Mr. Shoemaker died on December 28, 1958, leaving this manuscript nearly completed. It was prepared for publication by Thomas E. Bowman, U. S. National Museum, who added Fig. 2, *j*, to those drawn by Mr. Shoemaker.

[2] Named in honor of J. Bruce Bredin, sponsor of the Expedition.

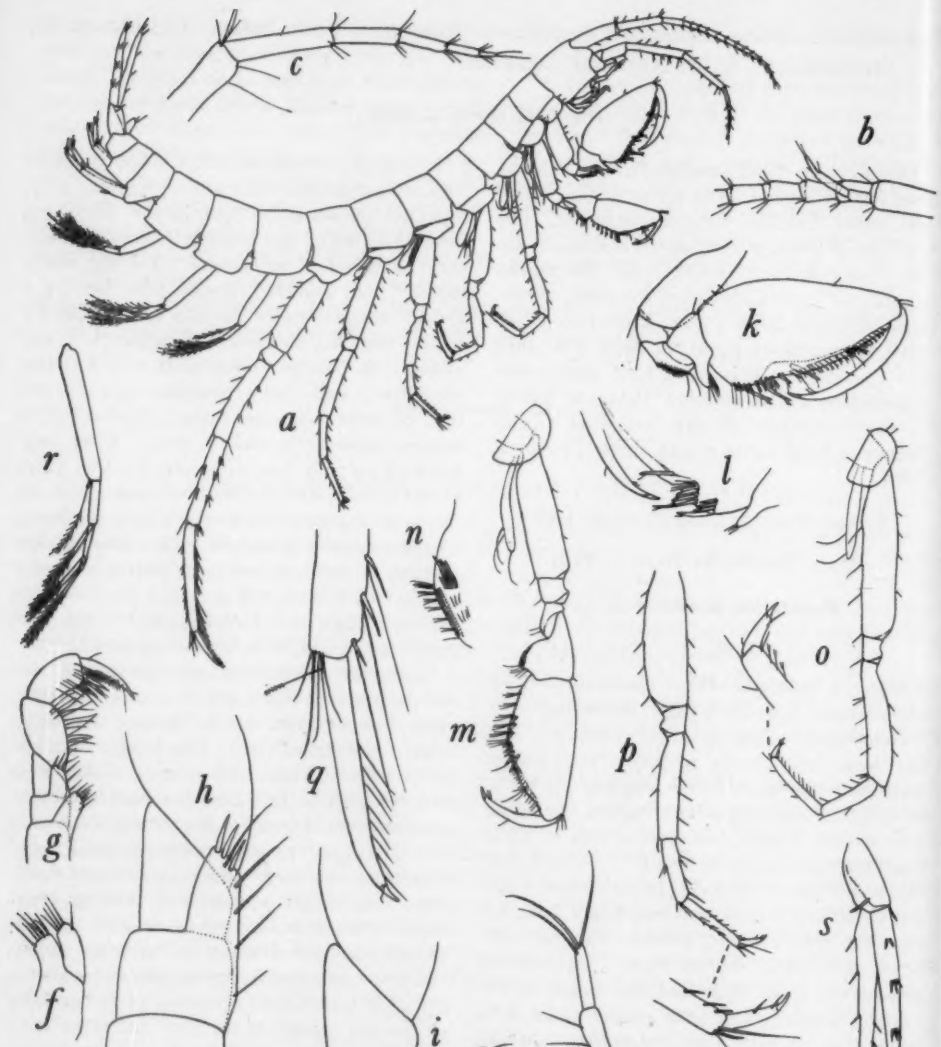


FIG. 1.—*Bogidiella bredini*, n. sp., female holotype: *a*, Entire animal, lateral; *b*, antenna 1, showing accessory flagellum; *c*, antenna 2; *d*, mandible; *e*, maxilla 1; *f*, maxilla 2; *g*, maxilliped; *h*, maxilliped enlarged, showing outer lobe; *i*, maxilliped enlarged, showing inner lobe; *j*, lower lip; *k*, gnathopod 1; *l*, gnathopod 1, sixth joint, inside of palm; *m*, gnathopod 2; *n*, gnathopod 2, inside rear margin of sixth joint; *o*, peraeopod 1; *p*, peraeopod 3; *q*, peraeopod 5, distal end; *r*, pleopod 1; *s*, uropod 3; *t*, telson.

sixth, with the lower lobe rather broad and carrying a few spines and a brush of fine scales or setae on rear margin; sixth joint widest in the middle, rear margin with 7 groups of spines; palm about as long as the rear margin of joint, very oblique, slightly convex, without defining angle, but having a row of 5 or 6 spines where the palm curves into the rear margin of joint; on the outside of the palm is a row of 15 or 16 slender curved bifurcate submarginal spines extending almost the entire length of the palm, and a group of 3 long slender spines near the center; on the inside of the palm near its juncture with the rear margin of the joint are 3 rows of spines, the first or distal of group consisting of 3 spines, the second group of 4 spines, and the third of 5 spines, below these spines are 2 groups of slender spines (Fig. 1, *n*) and a narrow brush of fine setae adjacent to the rear margin of the joint; seventh joint fitting palm, and resembling that of gnathopod 2.

Peraeopods 1 and 2 are alike and carry rather few spines. Peraeopod 2, second joint much longer than any of the following joints and little expanded; fourth joint not quite as long as the fifth and sixth combined; seventh joint short, nearly straight, with a spinule on the inner margin, and bearing a small nail with a seta at its base. Peraeopod 3, about as long as 2, but shorter than 4; second joint little expanded and much longer than any of the succeeding joints; fourth joint not quite as long as the fifth and sixth combined; seventh joint like that of peraeopods 1 and 2 but a little longer and having 2 spinules on inner margin. Peraeopod 4, like 3, but longer; seventh joint broken, so the number of spinules could not be determined. Peraeopod 5 very much like 4, but much longer and with longer and more numerous spines; second joint about as long as the fourth, which is about equal in length to the fifth; fifth joint a little shorter than the sixth; seventh joint nearly half as long as the sixth, slender, with 8 slender spinules on inner margin, a sensory seta on outer margin, and having a small nail with a seta at its base.

Uropods 1 and 2 reaching back about the same distance. Uropod 1, much longer than 2; peduncle nearly twice as long as the subequal rami, a spine on lower margin near the proximal end, and a spine at the distal end of the outer and inner margin; rami without lateral spines, but with distal spines. Uropod 3, very long, peduncle not half as long as the subequal rami, and bearing a spine on the upper outer margin and one at the distal end of the lower margin; outer ramus with 3 groups of lateral spines, and a group of terminal spines; inner ramus with 3 spines on inner margin, 2 on outer margin, and a group of terminal spines. Telson short, broader than long, sides convex, rear margin nearly straight and with 2 spines and 2 setae at either side.

Pleopods alike, but the third is the shortest. Pleopod 1, peduncle much longer than outer ramus, which consists of 3 joints, each consecutively shorter, and each bearing 2 plumose setae; inner ramus reduced to a very small single joint bearing a long terminal plumose seta. Pleopod 2 is like pleopod 1. Pleopod 3 is like 1 and 2, but shorter.

The coxal plates are all shallow and are as shown in Fig. 1, *a*. The metasome segments are as shown in Fig. 1, a. The branchiae occur on gnathopod 2 and peraeopods 1–4, and are rather narrow simple sacs. Marsupial plates occur on gnathopod 2 and peraeopods 1–3. The marsupial plates are narrow and rather short, and carry very few setae. Length of animal from front of head to the end of uropod 3, about 7 mm.

MALE: Length 5.8 mm. Its characters agree closely with those of the female, but several peraeopods are missing. A pair of small genital papillae is present on the ventral surface of the seventh peraeon segment; to the right one is attached a slender filament, coiled distally. Under high magnification the filament is seen to be made up of minute granules, which appear to be spermatozoa.

*Types.*—Holotype, female, U.S.N.M. no. 102418. Allotype, male, U.S.N.M. no. 102419.

Two species of *Bogidiella* have been described from the Americas, *B. neotropica* by Sandra Ruffo (1952) from a small brook, tributary to the Rio Cupari, Brazil, and *B. brasiliensis* by Rolf Siewing (1953) from Bahia and Ilhabela, Brazil. *B. neotropica*, described from a single specimen about 3 mm in length, is the largest species heretofore described, but it is much smaller than the present species which measures about 7 mm. In some of its characters *B. bredini* is much like *B. neotropica*, and whether the disagreements which occur are due to greater maturity of *B. bredini* or differences in sex, cannot be determined from the known material. The pleopods of *B. neotropica* have only one ramus each, while in *B. bredini* each has a well-developed outer ramus and a very much reduced inner one. In *B. neotropica* the accessory flagellum has 2 well-developed joints and

a smaller terminal joint, while in *B. bredini* there are 3 well-developed joints and a smaller terminal joint. No spines or setae are shown on the dactyls of the peraeopods of *B. neotropica*, but in *B. bredini* all of the dactyls have them, the last having as many as eight. *B. brasiliensis*, while less than 2 mm in length, has two rami to the pleopods, with the inner ramus much less reduced than in *B. bredini*. The telson is long in proportion to its width, and has a small median lobe distally. The first antenna is nearly twice as long as the second, and bears a unisegmental accessory flagellum.

Of the remaining three species of *Bogidiella*, only *B. skopljensis* (Karaman, 1933) from Skoplje, Yugoslavia, has biramous pleopods, and it differs markedly from *B. bredini* in the form and armature of the antennae, peraeopods, and telson.

Family GAMMARIDAE

Genus ***Metaniphargus*** Stephensen, 1933

***Metaniphargus nicholsoni,***[3] n. sp.

Figs. 2, 3, *a–o*

*Material examined.*—Thirty specimens from Dark Cave, Barbuda, collected during the Smithsonian-Bredin Expedition. Also, more than 100 specimens collected in Dark Cave by G. A. Seaman in November 1955 and donated by him to the U.S. National Museum.

*Description.*—MALE: Head and antennae are as shown for the female (Fig. 2,*a*), but possibly the antennae are a little longer in the male; accessory flagellum as long as the first joint of the primary flagellum and consisting of one long joint and a very short terminal joint. Eyes not present.

Upper lip symmetrical. Mandible, cutting-edge toothed; accessory plate strong, 3-pronged; spine-row of 2 stout plumose spines and several slender spines; molar strong, triturating surface narrow with a tuft of setae at the front end and a long plumose seta at the rear end; palp 3-jointed, first joint over half the length of the second, which is about equal in length to the third; third joint is pectinate on the lower margin and carries a distal group of long spines. Maxilla 1, inner plate broad and carrying about 20 long plumose setae on its straight outer margin; outer plate armed with 11 strong pectinate spine-teeth; palp 2-jointed, and armed distally with 6 strong spine-teeth and one long slender seta. Maxilla 2, outer plate wider, but a little shorter than the inner; inner plate carrying a diagonal row of closely-set plumose setae, besides the distal and marginal spines. Maxilliped, inner plate reaching beyond the middle of the outer plate, armed distally with 3 rather stout spine-teeth and a row of subdistal plumose setae which continues part way down the inner margin; outer plate reaches to about two-thirds the length of the second joint of the palp, armed distally with 3 long plumose spines, and on the inner margin with a row of about 11 stout spine-teeth and a submarginal row of slender spines; palp 4-jointed, fourth joint about two-thirds the length of the third, armed with a nail and carrying a diagonal row of 5 closely set ridges or setae on the inner surface. Lower lip without inner lobes, and with short blunt side lobes.

Gnathopod 1 (Fig. 2, *f*), shorter than 2; second joint expanded, a little longer than the fifth joint, a few short spines on front margin, 4 groups of long spines of 2 spines each on rear margin, and 3 long backward-directed submarginal spines near the proximal end of rear margin. Third and fourth joints short and rather stout, the fourth with a brush of setae on lower margin; fifth joint much longer and a little wider than the sixth, lower margin bearing 5 or 6 groups of spines, some of which are bifurcate at apex; front margin with a group of spines near the middle and a distal group; sixth joint about two-thirds as long as the fifth, widest in the middle, front margin slightly convex and bearing an apical and a subapical group of spines, rear margin straight and bearing three groups of spines, the longer of which are bifurcate at apex; palm transverse, slightly convex, smooth, defined on the outside by 3 slender bifurcate spines, with 3 shorter straight submarginal spines between these and the hinge of the seventh joint, and a curved spine just before the hinge, at the defining angle on the inside of palm are 2 short, stout bifurcate spines, 2 straight spines near the middle and a curved distal spine; seventh joint fitting palm, bearing a nail, which is about one-third the length of the joint, at the base of which are a forward-pointing tooth and a seta, inner margin with a submarginal seta, outer margin of joint with a forward-curving seta. Gnathopod 2 (Fig. 2, *h*) a little stouter and much longer than 1, second joint expanded, about as

[3] Named in honor of Desmond Nicholson, captain of the Expedition's vessel, *Freelance*, who collected the amphipods here described.

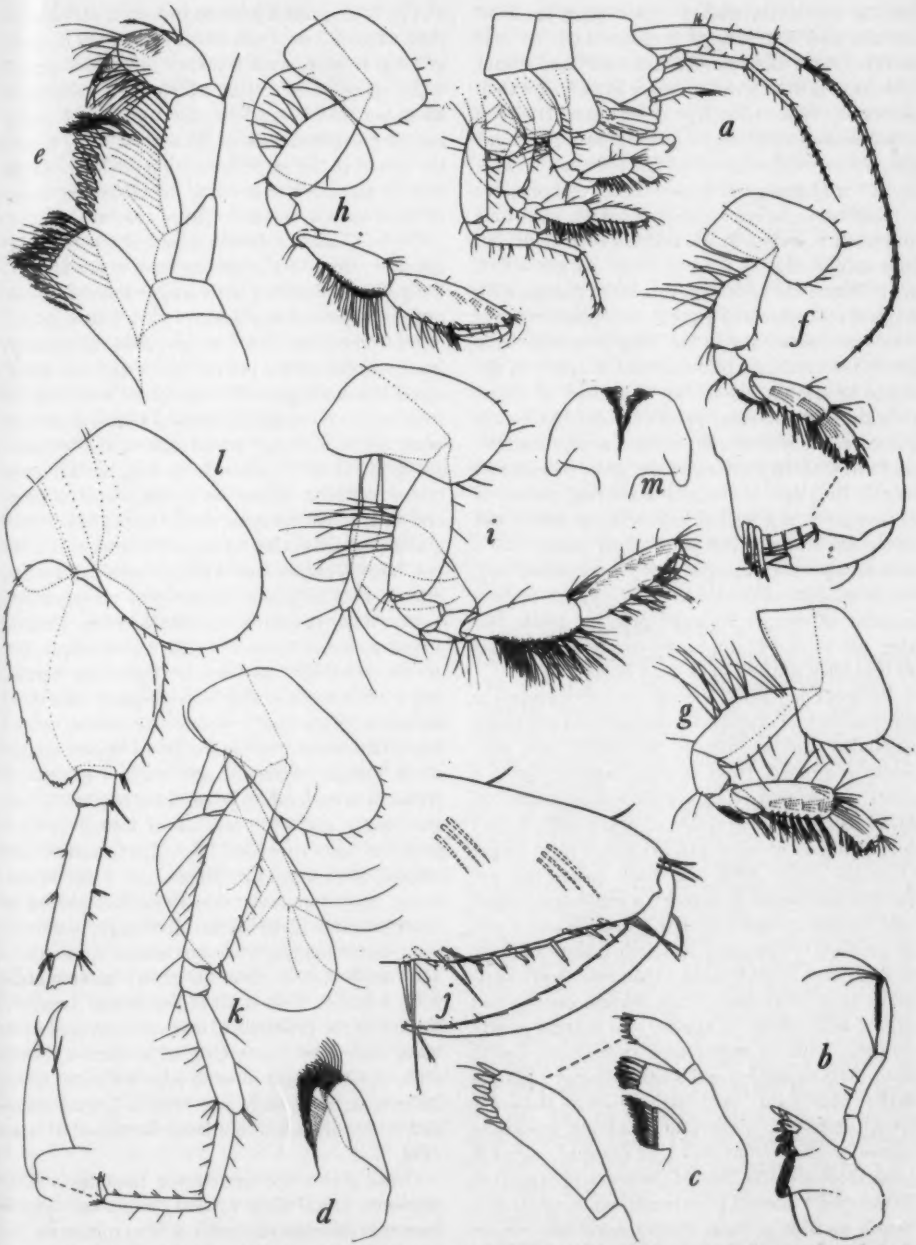


FIG. 2.—*Metaniphargus nicholsoni*, n. sp., *a–e*, *g*, *i–l*, female; *f*, *h*, male: *a*, Anterior end, lateral; *b*, mandible; *c*, maxilla 1; *d*, maxilla 2; *e*, maxilliped; *f*, gnathopod 1; *g*, gnathopod 1; *h*, gnathopod 2; *i*, gnathopod 2; *j*, distal end of gnathopod 2; *k*, peraeopod 2; *l*, peraeopod 3.

long as the sixth, with a small spine on front margin, and 5 groups of 2 spines each on rear margin; third and fourth joints short and stout; fifth joint a little shorter and a little wider than the sixth, widest distally, outer margin with a small median spine and a distal group, rear margin convex, with a brush of fine spinules or setae and 10 or 11 groups of spines, the longest member of each being bifurcate at apex; sixth joint long and narrow, widest in the middle, both front and rear margin slightly convex, front margin with 2 short spines and a distal group, inner margin with a brush of 5 setae and 4 groups of spines, some of which are serrate and the longest one in each group is serrate and bifurcate at the apex; on the inside of the sixth joint are 6 groups of spines near the front margin; palm very oblique, nearly as long as the rear margin of joint, nearly straight, smooth, without defining angle, grooved along its length, the edges of the groove bearing a series of blunt spines, a group of long setae at either end of the groove; seventh joint fitting palm, with a seta on the outer margin near the proximal end, inside margin of joint has what appear to be a number of slender forward pointing teeth, but they are so closely appressed to the margin that at first they appear to be part of the cuticle.

Peraeopods 1 and 2, slender and about equal in size and form. Peraeopod 2, second joint not much expanded and as long as the fourth and fifth joints combined, front margin bearing about 6 short spines, rear margin with 4 short spines on lower half and 3 long spines on upper half; fourth joint scarcely at all expanded and a little longer than the fifth; fifth and sixth joints not expanded and equal in length; seventh joint short and bearing a short nail with a spinule and a seta at its base. Peraeopod 3, much longer than 2; second joint considerably expanded, about four-fifths as wide as long, front margin convex and armed with about 11 spines, rear margin nearly straight, with an upper and lower lobe; fourth joint little expanded and a little shorter than the fifth; fifth joint very little shorter than the sixth; fourth to sixth joints bearing groups of spines on their front and rear margins; seventh joint short and like that of the second peraeopod. Peraeopod 4, second joint considerably expanded, nearly as wide as long, front margin less convex than in 3 and armed with 10 spines, rear margin slightly convex and with an upper and lower lobe; the third to seventh joints are like those of peraeopod 3, but longer and a little stouter. Peraeopod 5 (Fig. 3, *f*), second joint narrower in proportion than that of 3 or 4, about three-fourths as wide as long, front margin a little convex and armed with 7 spines, rear margin a little convex and with an upper and lower lobe, the upper lobe being not as pronounced as in peraeopod 3 or 4, and the spines in the serrations being stouter than in 3 or 4; the third to seventh joints are like those of peraeopod 4, but are a little stouter.

Uropod 1 and 2 extending back about the same distance; uropod 3 extending back much farther. Uropod 1, peduncle a little longer than the inner ramus, upper outer margin with 2 lateral and 2 distal spines, the lower of which is the stouter, inner margin with 2 lateral spines and one distal spine, lower margin with one spine; outer ramus without lateral spines but with a terminal group; inner ramus with one lateral spine and a terminal group. Uropod 2, peduncle as long as the inner ramus, without spines on upper outer margin, and with one distal spine on the upper inner margin; outer ramus shorter than the inner and without lateral spines but with a terminal group; inner ramus with one lateral spine on outer and one on inner margin and a distal group. Uropod 3, peduncle much shorter than outer ramus, but about two-thirds as long as the inner ramus, upper outer margin with 2 distal spines, and inner margin with one; outer ramus with a small second joint, first joint with 3 groups of spines on the outer margin, inner margin with 6 groups of spines, 2 in each group being short and stout, and one longer and plumose, distal margin with a group of spines; second joint short, narrow and conical, with a lateral spinule and 2 apical spinules; inner ramus slender, about half as long as outer ramus, and with sides converging to a sharp apex, outer margin with one lateral spine and a very small spinule near the apex; inner margin with 3 spines. Telson short, extending to about the end of the peduncle of uropod 3, divided to its base, each lobe converging to a narrow, sharp apex, outer margin of each lobe with one spine, inner margin of each lobe with 2 lateral spines and 2 apically, all spines being branched at apex (Fig. 3, *o*).

Coxal plates 1–5 are deeper than their body segments. Coxal plate 1, front margin convex and rear margin concave, with a few spines on the front and lower margin. Coxal plate 2 like that of 1, but a little wider and deeper. Coxal plates 3 and 4 much alike, a little deeper than 2, and with lower margin evenly rounding. Coxal plate

5 is the largest and deepest, the front lobe is twice as deep as the rear lobe and extends down about two-thirds the length of the second joint of the peraeopod (Fig. 3, *b*). Coxal plate 6 with a small front lobe (Fig. 3, *e*). Coxal plate 7 is as shown by Fig. 3, *f*. Metasome segments are as shown for the female by Fig. 3, *h*.

Urosome segment 1 with a single small spinule on either side of the rear dorsal margin, and urosome segment 2 with 2 spinules similarly placed. Pleopods all well developed. There does not appear to be any unusual character at the base of the outer ramus of the third pair, such as occurs in *M. curasavicus*. The branchiae occur on gnathopod 2 and peraeopods 1–4, and are large, oval, simple and attached to the limb by a peduncle. Length of the male about 7 mm.

FEMALE: The female is very much like the male and differs only in detail. All of the figures here given of the female or of a fully developed ovigerous specimen. The head, antennae and front part of the female are shown by Fig. 2, *a*. Gnathopod 1 is proportionately shorter and stouter than in the male; fourth joint with a brush of fine setae on lower margin; the palm of the sixth joint is transverse, smooth, with 3 short median spines, a curved spine at the base of hinge, and 3 short stout bicuspid spines on the outside at the defining angle, and on the inside at the defining angle are 3 long slender spines which appear to have 3 apical branches; the seventh joint has on the outer margin a sensory seta, and on the inner margin one or 2 small teeth or spines proximally, and a long nail with a forward-pointing tooth and a seta at its base. Gnathopod 2 is a little stouter than that of the male.

Peraeopods 1 and 2 very much like those of the male. Peraeopod 3 much like that of the male; longer than peraeopod 2, but shorter than 4, which is about as long as 5; the front lobe of its coxal plate is even larger in proportion than that of the male. Peraeopods 4 and 5 much like those of the male, but the second joint is longer and narrower in proportion, and that of 4 has the upper rear lobe more developed. The metasome segments are as shown by Fig. 3, *h*. The first urosome segment has one dorsolateral spinule on either side, and the second segment has 3 on either side (Fig. 3, *i*). The pleopods are like those of the male.

Uropods 1 and 2 are alike in both sexes. Uropod 3 is like that of the male, but is somewhat less spinose. The telson is very similar to that of the male; outer margin of each lobe with 2 marginal spines, inner margin with one lateral spine and one just below the apex, all the spines being branched apically (Fig. 3, *n*). The branchiae are like those of the male, and occur on gnathopod 2 and peraeopods 1–4. The marsupial plates are narrow, and carry few setae (Fig 2, *i*, *k*). The female reaches a length of 7.5 mm.

*Types.*—Holotype, male, U.S.N.M. no. 102424; allotype, female, U.S.N.M. no. 102425; and 28 paratypes, all from Dark Cave, Barbuda, collected by Desmond Nicholson, April 25, 1958.

*M. nicholsoni* is very similar to *M. beattyi* Shoemaker, 1942, from slightly brackish water in a deep well, St. Croix, Virgin Islands.[4] It differs in details of the armature of the appendages and most obviously in the shape and armature of the telson. In *M. beattyi* the telson is relatively shorter and broader; each lobe bears two apical spines and a single spine on the distal part of the outer margin; there are no spines on the margins of the cleft as in *M. nicholsoni*. In *M. curasavicus* Stephensen, 1933, however, the armature of the telson is more similar to that of *M. nicholsoni*.

***Paraweckelia***, n. gen.

Head with prominent lateral lobes, and without eyes. Antenna 1 longer than antenna 2, with a 4-jointed accessory flagellum. Upper lip symmetrical. Mandible with toothed cutting-edge, strong accessory plate, well-developed molar, and a 3-jointed palp. Maxilla 1 with a row of plumose setae on inner plate, 9 spine-teeth on outer plate, and a 2-jointed palp. Maxilla 2 without a diagonal row of spines or setae on inner plate. Maxilliped with inner and outer plates well developed, and with a 4-jointed palp. Lower lip with inner lobes. Gnathopod 1 smaller than 2; both subchelate. Gnathopod 1 with fifth joint longer than the sixth; palm of sixth joint only slightly oblique. Gnathopod 2 with fifth joint much shorter than sixth and with a rear lobe. Peraeopods 3–5 with expanded second joint. Coxal plate 4 incised in rear. Pleopods normal, not reduced. Uropods normal and with all rami well developed. Uropod 3 with 2-jointed outer ramus. Branchiae simple, not attached by a pedicel. Marsupial plates narrow, with few setae. Telson cleft to base. Type, *P. silvai*, n. sp.

[4] Stephensen (1948) considered *M. beattyi* to be identical with *M. curasavicus* Stephensen, 1933, from Aruba, Curaçao, and Bonaire. It has not been possible to determine from Mr. Shoemaker's notes whether he agreed with Stephensen.—T. E. BOWMAN.

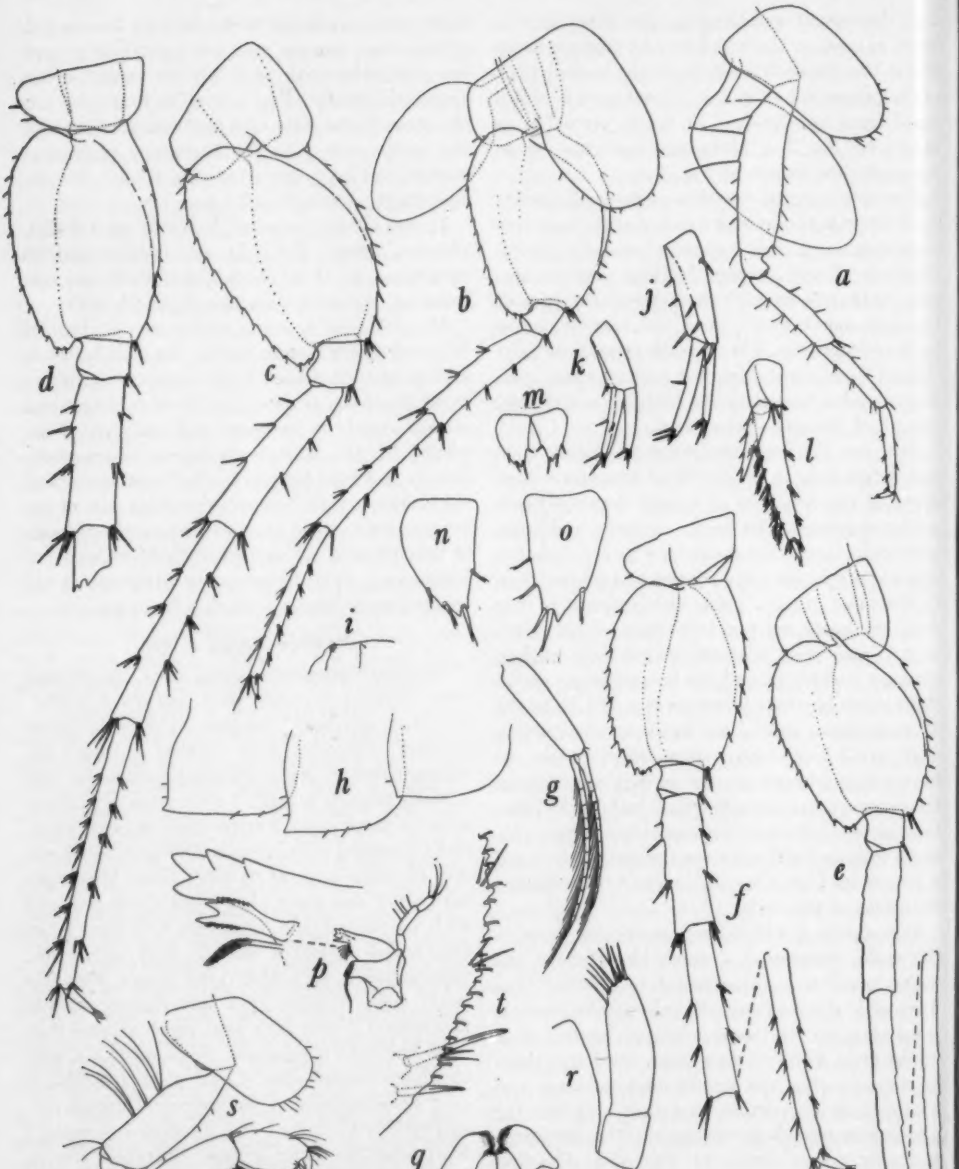


FIG. 3.—*a–o*, *Metaniphargus nicholsoni*, n. sp.: *a*, Peraeopod 2, male; *b*, peraeopod 3, male; *c*, peraeopod 4, female; *d*, peraeopod 5, female; *e*, peraeopod 4, male; *f*, peraeopod 5, male; *g*, pleopod 1, female; *h*, metasome segments, lateral, female; *i*, urosome segments, lateral, male; *j*, uropod 1, female; *k*, uropod 2, female; *l*, uropod 3, female; *m*, telson, female; *n*, left half of telson, female; *o*, right half of telson, male. *p–t*, *Paraweckelia silvai*, n. sp., female: *p*, Mandible; *q*, lower lip; *r*, maxilla 1, palp; *s*, gnathopod 1; *t*, palm of gnathopod 2.

***Paraweckelia silvai,***[5] n. sp.

Figs. 3, *p–t*; 4

*Material examined.*—Ten specimens, collected by Gilberto Silva Taboada in a fresh-water lake, Lago Martí, in Cueva Grande, the largest of the Caguanes Caves, a group of five caves located in Punta Caguanes, north coast of Las Villas Province, Cuba, February 1958.

*Description.*—FEMALE: Head with prominent rounding lateral lobes. Without eyes. Antenna 1, longer than 2; first joint equal in length to the second; third joint nearly half the length of the second; flagellum composed of about 30 joints; accessory flagellum of 4 joints. Antenna 2, first joint nearly circular and very prominent, gland-cone prominent; third joint about one-third as long as the fourth, which is equal in length to the fifth; flagellum not as long as the peduncle and composed of about 12 joints, the first of which is the longest.

Upper lip, symmetrical. Mandible, cutting-edge toothed, accessory plate, strong, armed with 2 distal teeth, a row of smaller teeth on outer margin and a brush of setae on inner margin (Fig. 3, *p*); spine-row of seven spines; molar prominent, its base produced forward into a narrow prominent process which extends beyond the base of the palp; triturating surface rather long and narrow and carrying a long plumose seta; palp 3-jointed, second joint longest, first and third being equal in length, second and third joints with very few spines. Maxilla 1, inner plate with 7 plumose setae; outer plate with 9 toothed spine-teeth; palp 2-jointed, and armed distally with 8 slender spines. Maxilla 2, inner and outer plate about the same size and length and each carrying very few spines; inner plate without diagonal row of spines. Maxilliped, inner plate reaching to about the base of the second joint of the palp and armed distally with 5 slightly curved spine-teeth and a row of plumose spines or setae which extends part way down the inner margin; outer plate not extending to the middle of the second joint of palp, armed distally with several spines, inner margin armed with rather stout spine-teeth and a few slender spines; palp, with 4 joints, the second of which is much the longest; fourth joint almost as long as the third, with a comb of fine setae or spinules on inner surface, and with a small nail. Lower lip with broad outer lobes, narrow inner lobes, and with short blunt lateral processes.

Gnathopod 1, smaller than 2, second joint expanded and not quite as long as the fifth and sixth combined; fourth joint with a brush of setules and a few spines on rear margin; fifth joint longer than the sixth and with about 9 groups of long spines on rear margin; sixth joint widening distally, front margin with a few spines, rear margin with 2 groups of spines, palm convex, very finely toothed throughout, defined by a spine with a long thin branch, armed with about 7 submarginal branched spines, and with a curved spine just before the hinge of the seventh joint; inside of palm with a group of 5 spines at the defining angle, and with about 12 submarginal branched spines; seventh joint fitting palm, a sensory seta on the outer margin and 3 setules on inner margin. Gnathopod 2, second joint not much expanded and not as long as the sixth; fourth joint with rear margin produced forward rather sharply; fifth joint, front margin with one median spine, lower margin with a few spines; sixth joint very large, widest through the center, front margin with a few scattered spines and a distal group, rear margin with 4 groups of spines, palm convex, longer than the rear margin of the joint, crenulate, armed with about 18 short branched spines and defined by a long spine on the outside and one on the inside, each of which has a long slender branch (Fig. 3, *t*); seventh joint fitting palm, and apparently unarmed.

Peraeopods 1 and 2 slender and nearly equal in form and length. Peraeopod 1, second joint very little expanded, as long as the fourth and fifth combined; fourth joint very little expanded and about as long as the sixth; fifth joint shorter than the sixth; seventh joint about a third as long as the sixth, with a spinule on inner margin, and with a curved nail. Peraeopod 3, longer than 1 or 2, but shorter than 4, second joint expanded, front margin convex and spinose, rear margin almost straight, slightly serrate, spinose, and with a lower lobe; fourth joint little expanded and not as long as the fifth; fifth joint not as long as the sixth; seventh joint about a fourth as long as the sixth joint, and much like that of peraeopod 1. Peraeopod 4, shorter than 5; front and rear margins of second joint convex and spinose, rear margin with a rather shallow lower lobe; fourth, fifth, and sixth joints proportionately

[5] Named in honor of Gilberto Silva Taboada, who collected the new species and donated them to the U. S. National Museum.

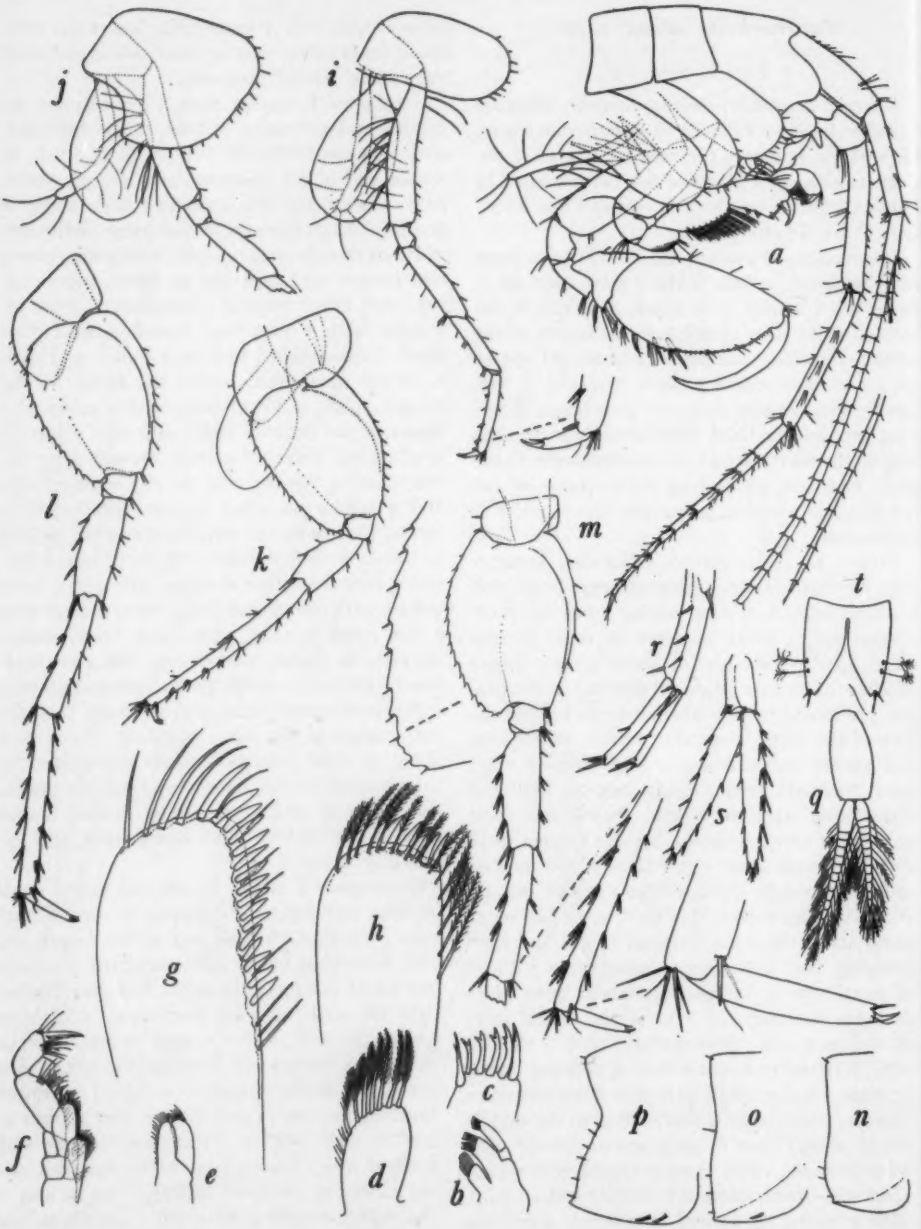


FIG. 4.—*Paraweckelia silvai*, n. sp., female: *a*, Anterior end, lateral; *b*, maxilla 1; *c*, maxilla 1, apex of outer plate (only 6 of the 9 spines shown); *d*, maxilla 1, inner plate; *e*, maxilla 2; *f*, maxilliped; *g*, maxilliped, outer plate; *h*, maxilliped, inner plate; *i*, peraeopod 1; *j*, peraeopod 2; *k*, peraeopod 3; *l*, peraeopod 4; *m*, peraeopod 5; *n*, *o*, *p*, metasome segments 1, 2, and 3, respectively, lateral; *q*, pleopod 3; *r*, uropod 1; *s*, uropod 2; *t*, telson.

as in peraeopod 3, but longer; seventh joint about a third as long as the sixth. Peraeopod 5, proportionately much like 4, but longer; second joint with upper rear margin straight; seventh joint straight, about a third as long as the sixth, and is as shown by Fig. 4, *m*.

Coxal plates 1–4 deeper than their body segments, the first three with evenly rounding spinose lower margins. Coxal plate 4 much broader than the preceeding, rear margin deeply incised. Coxal plate 5, with a shallow front lobe. Coxal plates 5–7 as shown in Fig. 4, *k*, *l*, *m*.

Branchiae are simple oval sacs, without pedicels, and occur on gnathopod 2 and peraeopods 1–4. The marsupial plates are narrow, carry few setae and are attached to gnathopod 2 and peraeopods 1–3. The metasome segments are as shown by Fig. 4, *n*, *o*, *p*. Metasome segments 1–3 and urosome segment 1 each has two posteromedian dorsal setae, and urosome segment 2 has a small spine on either side of the posterodorsal surface.

Pleopods, normal and well developed, outer ramus the shorter.

Uropod 1 reaches back a little farther than 2, and uropod 3 much farther than 1. Uropod 1, peduncle much longer than inner ramus, which is longer than the outer; the armature of spines is shown by Fig. 4, *r*. Uropod 2, much like uropod 1, but there are no spines on the peduncle except the distal one. Uropod 3, peduncle about a third as long as the outer ramus, which has small, narrow second joint; inner ramus a little shorter than the outer, and the spine arrangement of the uropod is shown by Fig. 4, *s*. Telson reaches back to about the end of the peduncle of uropod 3, about as broad as long, cleft nearly to its base, each lobe converging to a narrow indented apex containing a spine and a seta, and each outer lateral margin bearing 2 plumose setae. Length from front of head to end of uropod 3, about 12 mm.

MALE: The male is like the female, and can be distinguished only by the absence of marsupial plates and the presence of male genitalia. The males in the present lot are about the size of the females except the male type which measures about 15 mm.

*Types.*—Holotype, male, U.S.N.M. no. 102461. Allotype, female, U.S.N.M. no. 102462, and eight paratypes.

The new genus, *Paraweckelia*, is closely related to the genus *Weckelia* Shoemaker, 1942, containing the single species *W. caeca* (Weckel) from Modesta Cave, near Cañas, Cuba. The most important difference is in the structure of the mandibular palp, which consists of the usual three joints in *Paraweckelia*, but is reduced to a single small joint in *Weckelia*. In addition, the oblique row of setae on the inner plate of the second maxilla of *Weckelia* is absent in *Paraweckelia*.

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# ZOOLOGY.—Antrogonodesmus, *a new chelodesmoid genus from Cuba, and a redescription of* Amphelictogon dolius *Chamberlin (Polydesmida, Chelodesmidae).*

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(Received June 16, 1959)

So far less than 80 species of Diplopoda have been recorded from Cuba, a small number which reflects inadequate collecting rather than an impoverished fauna. More than half of the known species have been taken in the mountains of Oriente Province, and it seems reasonable to presume that attention to other parts of the island will greatly augment our knowledge of the millipeds of Cuba. The first large contribution to this general subject was made in 1918, when R. V. Chamberlin described a considerable number of Cuban species (unfortunately without illustrations), the majority of which are still known only from the original types. In recent years H. F. Loomis has added a large number of new species to the list, and redescribed some of the older ones.

Two separate collections of Cuban diplopods, received by the U. S. National Museum and kindly transmitted to me for study by Dr. Ralph E. Crabill, are of exceptional interest. One includes a remarkable new genus of the Chelodesmidae without close relatives elsewhere in the family; the other contains male specimens of *Amphelictogon dolius*, a species originally based on females and not subsequently rediscovered.

## Family CHELODESMIDAE Cook

The status of this name has been the subject of much dissention ever since its proposal in 1895, but with the recent discovery that the type genus is subjectively synonymous with the older name *Eurydesmus*, plus the latest (Copenhagen, 1953) decisions concerning the formation of family names, there can hardly be any doubt that it is the correct name for the group of genera which has long been called the family Leptodesmidae by most European workers. A detailed study of classification within the limits of this huge group and its satellite families is in preparation at this time, and should settle the question of how much ground should be covered by the name Chelodesmidae in a stricter sense than now employed.

On the basis of work completed to date, it can safely be said that of the two genera here discussed, at least *Amphelictogon* is very closely related to both *Eurydesmus* and *Leptodesmus*, falling in the same family with the former and in the same subfamily or tribe with the latter genus. This association is made on the basis of comparison with material of species strictly congeneric with the type species of the three genera named, including newly-found characters of antennal structure, form of the 2nd leg pair, body shape and proportion, paranotal configuration, and formation of the male genitalia. Less can be said concerning the status of *Antrogonodesmus* although it is obviously a member of the Chelodesmidae in a restricted sense.

### **Antrogonodesmus**, n. gen.

*Type species.—Antrogonodesmus curiosus*, n. sp.

*Diagnosis.*—A remarkable chelodesmid genus differing from all other known genera by the form of the gonopods. The coxae are normal for the family in shape, mode of connection, and presence of a long coxal process, but the prefemora are greatly enlarged and impressed on the ventral side into a deep cavity densely beset with long macrosetae. The prefemoral process is short and distally biramous, one of the divisions forming a shield for the solenomerite. The latter is short and laminate, slender, unmodified, largely concealed by the prefemoral process and by a femoral process which is somewhat expanded and functioning as a solenophor.

Body form chelodesmid, e.g., with the anterior four of five segments broadest and the following paranota becoming gradually reduced in size in going caudad and well separated from each other by the large prozonites which are only partly included by the preceeding metazonites. A distinct interzonal furrow in the segmental constriction. Pore formula normal, the pores opening near the end of slender elongate peritremata. Tergites, pleurites, and sternites all smooth and glabrous, without any surficial modifications. Legs long and slender, virtually glabrous, those of the male sex with distinct

tibial pads extending back as far as the eighth segment.

**Antrogonodesmus curiosus,** n. sp.

FIGS. 1–4

*Type specimens.*—Male holotype and female paratype, U. S. Nat. Mus. (Myriapod Type no. 2581), from San Vicente, Pinar del Río Province, Cuba, collected in June 1956, by N. L. H. Krauss.

*Diagnosis.*—With the characters of the genus. Specific characters probably are reflected in the size, color pattern, and gonopod configuration.

*Description.*—Male holotype: an elongate, slender, caudally attenuate chelodesmoid, the paranota of segments 2–4 rather broad, transverse, almost horizontal, subrectangular, those following gradually decreasing in size. Length, approximately 34 mm., widths of selected segments as follows:

| | |
|---|---|
| Collum | 5.1mm |
| 2d | 5.2 |
| 3d | 5.1 |
| 4th | 5.0 |
| 6th | 4.6 |
| 10th | 4.5 |
| 16th | 4.1 |
| 18th | 3.2 |

Body chiefly tan to a light testaceous-brown, the intersegmental constriction more darkly pigmented across dorsum. Caudolateral corners of paranota, *the entire collum,* and large middorsal spots on the 2d and 3d segments chalky white. Antennae, legs, and underparts light tan to nearly colorless.

Head convex, smooth, polished, the vertigial groove very distinct and extending down to middle of interantennal isthmus. latter broad, twice length of first antennal article. Frons and clypeus with numerous scattered setae, these extending laterad well onto the genal surfaces, latter only slightly convex without flattened margins, a little sinuate. Labrum with about 28 stout setae, the series merging into the 3 large genal marginal setae on each side.

Antennae moderately long (5.0 mm) and slender, reaching back to 3rd segment; all of the articles moderately setose but vestiture increasing distally; article 7 cylindrical, apically rounded, the free margin inturned between and separating the 4 sensory cones, outer (dorsal) side of article with a small rounded sensory area. Relative lengths of antennal articles, in decreasing order: 2-3-4-5-6-1-7 (perhaps abnormal).

Collum broader than head, smooth, convex, anterior margin an even arc, almost a semicircle; median fourth of caudal margin rather deeply concave. Anteriolateral edge of set off by a fine groove extending dorsad as far as base of mandibles. Lateral corners almost rectangular. A row of six widely spaced submarginal microsetae along the rear edge of the segment.

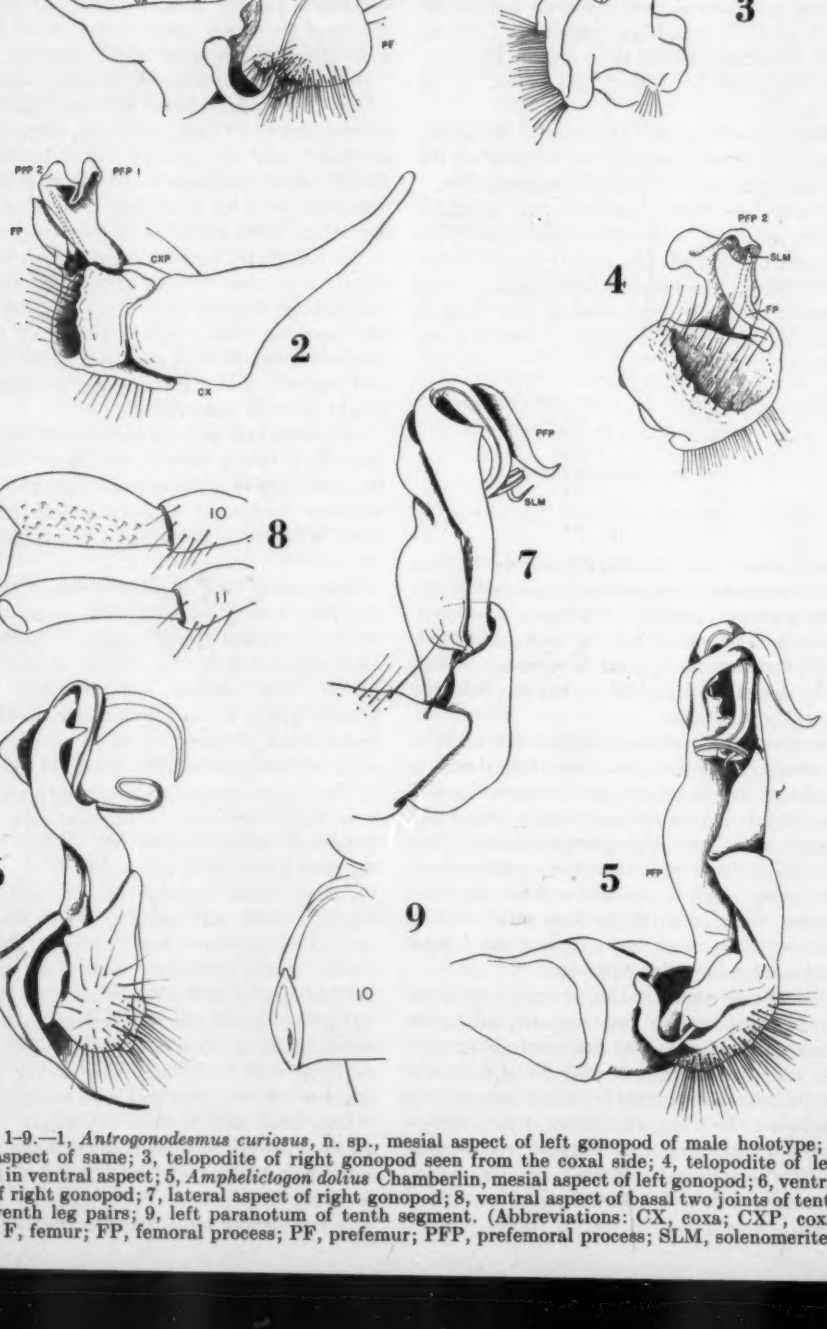
Second segment slightly broader than the others, the paranota broad and only slightly depressed, not tilted cephaloventrad; the paranota margined only on anterior edges, lateral and caudal edges continuous with dorsal surface. Segments 2–4 with small but distinct scapular dentations, these segments all essentially similar in size and shape. In going caudad from 5th segment the paranota become increasingly reduced, the anterior corners become more oblique and the posterior more acutely produced. On all poriferous segments the peritremata are elongate and slender, the pores opening dorsolaterally almost at their posterior ends.

Prozonites and metazonites of equal size, separated by a broad, smooth, interzonal furrow in the convexity of a distinct intrasegmental constriction. Surface of segment smooth and polished, without granulations or perceptible setal sockets.

Paranota of 19th segment rudimentary lobes just large enough to carry the pores, scarcely extending beyond caudal margin of the segment. Anal segment small, the epiproct short, bluntly conical, bent slightly ventrad. Anal valves smooth, with a median setiferous convexity, the mesial edges produced as raised rims, the marginal setiferous tubercules small, set quite high on the valves, and separated from the marginal rims. Hypoproct large, subcircular, the median projection broad and low but distinct between the small paramedian tubercules.

Pleural areas entirely smooth, unadorned; stigmata small and opening almost flush with the surface just above and in front of the coxae. Sterna broad, glabrous, unmodified, the legs inserted into an abruptly elevated podosternum, this not produced into subcoxal spines or knobs, but distinctly notched between the coxae on each side and with the caudal side deeply concave between the last legpair of each segment.

Legs long and slender, the joints virtually glabrous except for a ventral macroseta on each coxa and prefemur, and some microsetae on the following three joints. Tarsus sparsely invested with fine slender setae, these distinctly procum-




FIGS. 1–9.—1, *Antrogonodesmus curiosus*, n. sp., mesial aspect of left gonopod of male holotype; 2, lateral aspect of same; 3, telopodite of right gonopod seen from the coxal side; 4, telopodite of left gonopod in ventral aspect; 5, *Amphelictogon dolius* Chamberlin, mesial aspect of left gonopod; 6, ventral aspect of right gonopod; 7, lateral aspect of right gonopod; 8, ventral aspect of basal two joints of tenth and eleventh leg pairs; 9, left paranotum of tenth segment. (Abbreviations: CX, coxa; CXP, coxal process; F, femur; FP, femoral process; PF, prefemur; PFP, prefemoral process; SLM, solenomerite.)

bent. Pretarsus small, short, slightly curved. Leg joints in decreasing order of length: 3-6-5-2-4-1.

Tibiae of legs 1–10 with extruded arthrodial subtarsal pads, apparently a few others behind the 10th can be extruded also. Seminal processes of second coxae rudimentary, they open through a low conical swelling of the coxae. Sterna of anterior segments broad and without any trace of subcoxal knobs or processes. Anterior pretarsi also small and similar to the others.

Pleurae of segments 2–7 modified by a distinct groove from the caudal margin of the segments, curving cephaloventrad to form an arc just above the coxae, thence fading out toward the interzonal furrow. The low ridge formed by this groove is entirely smooth.

Gonopod aperture quite small, broadly transversely oval, about three times as wide as long, its edges produced distally into a complete circumgonopodal rim of moderate height. Aperture entirely confined to the metazonite of the seventh segment, not infringing even onto the course of the interzonal furrow.

Telopodites of gonopods, seen in situ, very small, not extending beyond prozonite of segment although the coxae of normal size for the bulk of the animal. Coxae attached by a very small, elongate sternal remnant, and with long slender apodemes, produced on the cephalic surface into an elongate subconical coxal process (CXP). Prefemora greatly enlarged especially on the ventral surface, which is largely occupied by a deep subcircular cavity, lined with long setae (Figs. 2 and 3), unlike anything now known in other chelodesmids. In mesial aspect, prefemora are short and broad, with a straight seminal groove proceeding distad to the base of the solenomerite. A large prefemoral process (PFP), distally expanded and divided into two subequal laminate lobes, the outer of which is terminally reflexed and curved to form a hoodlike structure covering the solenomerite (PFP 2) as seen in ventral aspect, Fig. 3. Two other gonopod processes, probably postfemoral in structure, are the solenomerite (SLM), a simple, slightly curved, mostly concealed blade carrying the seminal groove, and the femoral process (FP), which originates near the base of the solenomerite, and shields it on the ventral side.

Female paratype: similar to the male in most structural details, but the body somewhat larger with wider sterna and narrower paranota, and with the interzonal furrow more deeply impressed. The antennae are longer (5.8 mm), with articles 2–6 almost identical in size and shape. The color pattern is identical except that the 3rd segment lacks the median spot. The body form is less attenuated caudally. Length, 35.0 mm, widths of selected segments:

| | |
|---|---|
| 2d | 5.0mm |
| 10th | 4.9 |
| 16th | 4.9 |
| 18th | 3.8 |

*Remarks*:—Heretofore two chelodesmoid genera have been known from Cuba: *Amphelictogon* and *Cubodesmus*, both abundantly represented by species from the eastern half of the island. *Antrogonodesmus* is perhaps endemic to the western part of the island, geographically vicariating for the other two, but apparently not closely related to either of them. There is, in fact, no known genus with which it can be compared. The large prefemoral cavity is unique, and the relationship of the terminal processes almost so.

As regards body forms and details, *Antrogononodesmus* seems to have no close ties with Central American forms such as the dominant chelodesmid genus *Chondrodesmus*. Tibial pads on the male legs occur in numerous genera of South America, but the systematic significance of these structures has yet to be proven at least as regards tracing affinities of genera so provided.

With most of the collecting which has been done in Cuba restricted to the mountains of Oriente, it would be premature to speculate on the likelihood of a distinctive endemic fauna in the hills of Pinar del Río, yet such is suggested by the discovery of an unusual chelodesmid. Perhaps the intervening lowlands of Cuba have been largely submerged through the Tertiary to enhance the development of two distinct faunas. Further exploration west of Havana is certainly much to be desired.

### Genus **Amphelictogon** Chamberlin

*Amphelictogon* Chamberlin, 1918, Bull. Mus. Comp. Zool. **62**: 224.—Loomis, 1938, Bull. Mus. Comp. Zool. **82**: 460.—Attems, 1938, Das Tierreich **68**: 157; 1940, *ibid.* **70**: 552.—Loomis, 1941, Psyche **48**: 35.

*Type species.—Amphelictogon cubanus* Chamberlin, by orthotypy.

*Diagnosis.—Amphelictogon* is characterized primarily by the structure of the gonopods, which are rather small and project from a strongly modified sternal aperture. The coxae

are connected by a small but distinct, attenuate sternite, and are produced into a triangular projection partly concealing the lateral face of the prefemur. The telopodite projects directly distad from the prefemur as a rather straight stalk which, however, is bent abruptly retroproximad, strongly attenuated, and drawn out into a long coiled flagellum. Prefemoral process set off by a distinct articulation, extending distad as far as the geniculum of the telopodite, where it normally curves proximad as a slender falcate blade, occasionally with a terminal expansion or a subterminal accessory process.

Body form slender, collum and second segment widest, segments posterior to 4th becoming gradually narrower to end of body. Paranota widely separated by the large exposed prozonites, the two subsegments separated by a well defined interzonal furrow. Prozonite of 7th segment of males complete, not reduced in front of the gonopod aperture. Legs long and slender, without tibial pads, the pretarsi short and slender, unmodified. Pore formula normal, peritremata usually specialized and set off from margin of paranota.

Coloration variable, the dorsum dark brown with spots or bands or red, yellow, or white.

*Species.*—22, most of them from Oriente Province, Cuba, one from the Bahamas and one from Isle of Pines.

**Amphelictogon dolius** Chamberlin

Figs. 5–9

*Type specimens.*—Female holotype and paratypes, M. C. Z. nos. 5024–25, from Punta de Judas, 40 miles east of Caibarién, Santa Clara Province, Cuba, collected by Thomas Barbour in 1917–18.

*Diagnosis.*—The color pattern alone sets this species off from the other known species of *Amphelictogon*. On the basis of the gonopods, *dolius* is allied to *bidens* Loomis and *strumosus* Loomis in having the prefemoral process distally arcuate and slender and the telopodite femur with two marginal teeth. It differs from both in details of gonopod structure as well as color pattern.

*Description.*—Male: body elongate, slender, widest across collum and attenuate caudally; outline of body strongly moniliform, the prozonites large and broadly separating the metazonites. Paranota set high on sides and nearly horizontal. Length of specimen approximately 30 mm., widths of selected segments as follows:

| | |
|---|---|
| Collum | 4.5mm |
| 5th | 4.2 |
| 10th | 4.0 |
| 17th | 3.5 |

Segments rich chestnut-brown, head and antennae lighter brown; legs brownish pink, becoming reddish distally. Dorsum of paranota and adjacent part of the metatergites as well as tip of epiproct chalky white, each white spot wider than the brown of the intervening middorsal area.

Head capsule normal in appearance, convex, smooth; median groove of the vertex well defined. Clypeal region set with numerous long fine setae, the upper edge of the area limited by a transverse row of larger setae, above which only a few scattered setae occur on the lower frons. A pair of subantennal setae, and two pairs on the vertex is a transverse row, the setae of each pair set close together. Labrum fringed with about 40 long setae, intercalated with much shorter ones. Genae rather flat, evenly convex.

Antennae long (5.8 mm) and unmodified, articles 2–6 similar in size and shape, 1 very short, 7 subhemispherical, its distal edge turned in mesially between each of the 4 sensory cones and almost completely separating them; dorsal (outer) side of article 7 with a small rounded convex sensory area.

Collum broadly transverse, wider than head, surface evenly arched and smooth. Anterior margin evenly rounded through almost a half circle, posterior margin strongly bisinuate, i.e., with a median and two paramedian emarginations, the latter emphasizing the lateral corners of collum. Both edges set off by a submarginal groove, deepest at the lateral ends and obsolete across middorsum.

Second, third, and fourth tergites subsimilar in appearance but narrowing in width, paranota broadly transverse; anteriorly the margins are evenly rounded and set off by a distinct ridge, posteriorly the margins are bisinuate and set off with a fine ridge; caudolateral corners distinctly produced. Surface of metatergites smooth and polished, of prozonites finely shagreened, the two subsegments separated by a deep sharply defined interzonal furrow.

Segments 5 through 19 narrower than the preceeding, the anterior paranotal corners increasingly reduced along with width of the paranota, the prozonites proportionately more conspicuous along middle of body. Lateral margins of segments 17–19 scarcely divergent from median body axis, paranotal angles directed caudad,

abruptly smaller on segment 19. Poriferous segments (5, 7, 9, 10, 12, 13, 16–19) similar to others except for the strongly differentiated peritremata, these elongate pyriform, the upper surface flattened, pore directed dorsolaterad (Fig. 9). Caudal edges of paranota margined, but none produced into marginal dentations.

Epiproct subconical in dorsal aspect with a small cylindric truncate apex beyond the terminal whorl of macrosetae; lateral tubercules of both whorls large and interrupting the curve of the sides. Disc of anal valves convex, smooth, surface of basal third of valves vertically striate, mesal edges very strongly compressed, each valve with an oblique secondary ridge projecting from about the basal sixth and extending cephaloventrad to near the lateral ends of the hypoproct. Latter about twice as wide as long, with the ends acutely rounded and the distal edges nearly straight, and with a large and distinct median terminal lobe. Setiferous tubercules small and removed from the edges.

Pleural and ventral surfaces smooth and nearly glabrous, the former without pleural carinae or other modifications. Interzonal furrow continues well-defined around the segments in a strong constriction between prozonites and metazonites.

Legs inserted upon a distinctly elevated podosternum, which is not produced into subcoxal processes, and glabrous except for a row of 10–14 setae across the anterior surface above the interzonal furrow and a few scattered setae in general located near the coxal sockets. Legs long (up to 5.2 mm) and slender, the joints in decreasing order of length: 3-6-5-4-2-1. Basal two joints glabrous except for a few long ventral macrosetae, distally the joints are increasingly setose. Most legs are similar in proportion except the 9th and tenth pairs, the femora of which are conspicuously enlarged with the ventral surface flat or subconcave, ornamented with numerous flat tubercules each of which bears a tiny curved seta (Fig. 8).

Anterior legs smaller than the others but similar in form, without tibial pads or other modifications. Seminal ducts open flush with the surface of the 2d coxae. Sterna between the 3d legs (4th segment) produced into two contiguous elongate mounds; sterna between fourth legs produced into 2 low subconical knobs; the other sterna unmodified. Pretarsi short, slightly curved, somewhat compressed.

Prozonite of seventh segment not infringed upon by the small aperture of the gonopods and generally similar to adjoining segments. The aperture with the edges produced distad forming a circumgonopodal sheath, the rim of which is flared and recurved toward the body. Gonopods large, extending cephalad onto the 6th segment, not in contact mesially or but slightly so; the coxae joined by a small elongate sternal remnant, without a coxal process, but extending somewhat behind the prefemora on the lateral side.

Prefemora rather small, densely setose. Prefemoral process elongate, as large as main part of telopodite, terminating distally in a slender, simple, attenuated curved process, the inner edge of the process provided just beyond the midlength with three rounded projecting lobes. Femora short, flat, glabrous, separated from the more distal part of the telopodite by a deep (flexible?) groove or cingulum. Postfemur elongate, slender, the basal half with two acute projections along the mesial edge; just beyond the distalmost projection the telopodite is abruptly reflexed proximad and drawn out into a long coiled flagellum (Figs. 5–7).

Female: similar in structure to the male but somewhat larger, the tergites wider (4.6 mm at tenth segment, 5.0 mm at second). Color pattern similar to that of male except that the collum is completely ringed with white.

*Remarks.*—This species has heretofore been known only from the type locality. The material described originated at the Cueva de Colon, in Matanzas Province, Cuba, extending the known range about 130 miles to the west.

*Amphelictogon dolius* appears to be remarkable for the enlargement of the femora of legs 9 and 10. Whether such modification is unique in this species or merely overlooked in others I cannot guess. In the form of the gonopods *dolius* is very much like Loomis's species *bidens* and *strumosus*, but differs so much in color pattern from both that subspecific status seems unlikely. Probably actual comparison of specimens of the three will provide various points of difference not apparent from the published descriptions.

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# ICHTHYOLOGY.—Bathypterois pectinatus, *a new bathyal iniomous fish from the eastern Pacific.*

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The holotype of the distinctive species described below has been available during my review of the western Atlantic fishes of the family Bathypteroidae. It was compared with all known north Atlantic species (Mead, 1959: 369); with the type or syntypes of the Pacific *Bathypterois ventralis* Garman, *B. pectoralis* Garman, and *B. antennatus* Gilbert; with specimens representing *B. longipes* Günther and several variations of the cosmopolitan but poorly-understood groups of species now known as *B. antennatus* and *B. atricolor*. The study of a second specimen, caught by the *Vema*, has shown clearly that this form is not an extralimital subspecies or variant of the Atlantic *B. quadrifilis* Günther but a distinct although related species.

**Bathypterois (Bathypterois) pectinatus,** n. sp.
Fig. 1

*Holotype.*—A specimen 142.1 mm in standard length caught by the U. S. Fish Commission steamer *Albatross* at station D. 4654, 24 miles off Aguja Point, Peru (lat. 05°46′ S., long. 81°32′ W.) on November 12, 1904, at a depth of 1,036 fathoms. U. S. National Museum no. 150029.

*Paratype.*—A 123.0-mm specimen taken by the R. V. *Vema* of the Lamont Geological Observatory from L.G.O. Biotrawl no. 122, Panama Bay (lat. 07°25′ N., long. 79°23′ W.) on November 14, 1958, at a depth of 956 fathoms (corrected). American Museum of Natural History no. 20401.

*Diagnosis.*—Posterior ventral procurrent caudal ray modified into a hook or notch. Upper prolonged and stiffened pectoral rays fused basally but divided from one another at a point anterior to the origin of the dorsal fin; these upper strong rays followed by at most one rudimentary pectoral ray. Base of lowermost pectoral fin ray about as thick as that of the adjacent ray. Scales beneath proximal part of pectoral fin strongly pectinate. Body black and without pattern; the edges of the scale pockets white. Caudal fin white; dorsal, anal, and ventral fins dusky.

*Bathypterois pectinatus* is closely related to *B. quadrifilis*, a species known from the western Atlantic (off Brazil, in the Gulf of Mexico and the western Caribbean, and off Grenada and St. Vincent in the British West Indies) at depths from 470 to 655 fathoms. It differs from *B. quadrifilis* in the thickness of the lowermost pectoral ray, by its colorless caudal fin and dusky dorsal and anal fins (all are black in *B. quadrifilis*), by its less-deep body, and in the extent of the scaly covering over the proximal part of the caudal fin (this covering extends out on to the caudal lobes in *B. quadrifilis* but is restricted to the area over the bases of the caudal rays in *B. pectinatus*).

*Description.*—The following counts and measurements (expressed in percent of standard length) are those of the holotype (142.1 mm) followed, in parentheses, by those of the paratype (123.0):

D.—14 (14). A.—9 (9). P. (upper part)—2,0/2,1 (2,1/2,1). P. (lower part)—9/9 (9/9). V.—8/9 (9/9). C.—I-16-II. Gill rakers (first arch)—12 + 1 + 29 (12 + 1 + 30). Branchiostegal rays—4 + 8 (5 + 8). Scales in lateral line—about 62. Vertebrae—59.

Length of head 21.3 (21.3), of snout 7.1 (6.7), of upper jaw 13.6 (13.3). Diameter of eye 2.0 (2.4); width of bony interorbital 7.9 (8.3). Greatest depth of body 14.6 (14.4), depth at origin of anal fin 10.6 (10.7), least depth of caudal peduncle 7.1 (7.0). Greatest width of body 8.2 (8.1). Snout to origin of dorsal fin 40.1 (41.3), to origin of anal fin 55.4 (55.7), to insertion of pectoral fin 18.3 (19.4), to insertion of ventral fin 35.5 (37.3). Base of last dorsal ray to insertion of adipose fin 23.7 (22.6); insertion of adipose fin to dorsal procurrent caudal ray 21.5 (22.2); base of last anal ray to ventral procurrent caudal

[1] One of the specimens on which this account was based was caught by the 1958 eastern Pacific cruise of the *Vema*, research vessel of the Lamont Geological Observatory, Columbia University, and was made available by Dr. Robert J. Menzies of that laboratory through Dr. Vladimir Walters of the American Museum of Natural History. Partial support for this cruise of the *Vema* was obtained from the U. S. Navy, Office of Naval Research, the Bureau of Ships, and the National Science Foundation. This paper constitutes contribution no. 363 of the Lamont Geological Observatory and no. 11 of the Biology Program.

ray 33.8 (32.6); insertion of ventral fin to anus 13.0 (11.8); anus to origin of anal fin 6.8 (7.6). Length of base of dorsal fin 13.2 (13.7), of anal fin 8.2 (8.1). Length of longest pectoral fin ray 89.6 (96.0), of longest ventral fin ray 32.2 (28.1).

Body compressed, snout depressed. Body deepest at origin of dorsal fin, this depth 1.5 in length of head. Depth at origin of anal fin 2.0 in head; least depth of caudal peduncle 3.0 in head. Greatest width of body, anterior to dorsal fin, 1.8 in greatest depth.

Cheeks, top of head posterior to eye, and body covered with scales. Most body scales cycloid; those beneath anterior end of lower part of pectoral fin strongly pectinate and more adherent than most body scales. Body scales extend onto caudal fin; all other fins scaleless. One or two lateral line scales on caudal fin above the mid-caudal ray.

Head 4.7 in standard length, depressed and slightly convex above and before eye. Snout 3.0 to 3.2 in length of head. Sensory pores of head well developed, 4 to 6 in the horizontal series below the eye, about 8 along the lower outer surface of the mandible, and about 4 in each longitudinal series on top of head. Olfactory organ slightly closer to eye than to tip of snout, the nostrils separated by a thin membrane which bears a short flap.

Eye minute but larger than that of several other bathypteroid species, its greatest diameter equal to or greater than the combined width of the upper jaw bones (maxillary and supramaxillary) at their widest point. Pupil elliptical, but not keyhole-shaped. Interorbital broad and convex, 2.5 to 2.7 in length of head.

Branchiostegal membrane extending posteriorly beyond operculars, supported by 12 or 13 branchiostegal rays of which four or five originate on the epihyal. The membranes overlap anteriorly and are covered by a thick transverse gular fold. Gill rakers on all four arches, of the usual lathlike shape, spiny, and moderately long. Those near the angle of the first arch are about twice as long as the opposite gill filaments. No pseudobranchiae.

Maxillary broad and flat posteriorly, extending beyond posterior end of the premaxillary and surmounted by a slender supramaxillary which extends forward nearly or quite to beneath the posterior edge of the eye. Teeth on premaxillary minute, mostly depressible, and in a single band which is broader anteriorly than posteriorly. Symphysis of upper jaw without teeth. A patch of minute teeth on each side of the vomer, and a row of smaller teeth on each palatine. Mandible broad and heavy, with a bony toothless boss at the symphysis, the anterior half not included within or opposed to the upper jaw when the mouth is closed. Teeth in mandible small but larger than those in upper jaw, depressible and forming a band which is broader anteriorly than posteriorly. No teeth on the small tongue.

Dorsal fin inserted well behind axil of ventral fin, the length of its base 1.6 in length of head. Predorsal distance 2.4 or 2.5 in standard length. First two dorsal rays unbranched, the rest branched, the last divided to its base. Adipose

FIG. 1.—*Bathypterois* (*Bathypterois*) *pectinatus*, holotype, U.S.N.M. no. 150029. The figured scale was taken from beneath the anterior third of the lower part of the pectoral fin. (Drawn by Mildred H. Carrington.)

dorsal fin located about midway between posterior end of base of dorsal fin and first dorsal procurrent caudal fin ray, or slightly closer to end of base of dorsal fin. (The position of the adipose fin is variable in several bathypteroid species.) Preventral distance 2.7 or 2.8 in standard length, the length of the fin 3.1 to 3.6 in length of fish. Ventral fin normally with nine rays, but one side of the type has but eight. (The number of ventral rays is constant in the western Atlantic species.) The outer two ventral rays are simple, the rest branched. Base of second ventral ray about the same thickness as that of the third. Origin of anal fin behind a vertical from end of base of dorsal fin, the preanal distance 1.8 in standard length. First anal ray unbranched, the rest branched, the last divided to its base. (All fins except the ventrals and the adipose are broken in both specimens.) Upper two pectoral fin rays stiffened and elongate and fused basally, separating from one another anterior to the origin of the dorsal fin and extending beyond end of base of dorsal fin nearly to base of caudal. One or no rudimentary rays below these two fused and prolonged upper pectoral rays. All rays in lower part of pectoral fin broken.

Anus located about midway between insertion of base of inner ventral ray and origin of anal fin. A small urogenital papilla present, preceded by the ovopore.

Body black and without pattern. Edges of scale pockets white. Caudal and adipose fins white. All other fins, snout and under surface of lower jaw dusky.

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Happy is he who has knowledge
That comes from inquiry. No evil he stirs
For his townsmen, nor gives himself
To unjust doings,
But surveys the unaging order
Of deathless nature, of what it is made,
And whence, and how.
In men of this kind the study
Of base acts never finds a home.

—EURIPIDES.

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EDITOR'S NOTE.—The August and September numbers of the Journal are combined in one issue, as will also be the October and November numbers. Only 10 issues will be published in Volume 49.